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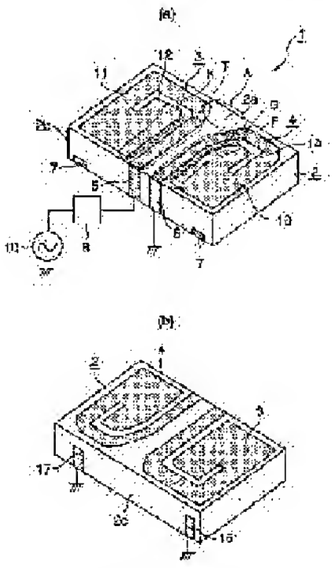
(54) SURFACE MOUNT TYPE ANTENNA AND RADIO APPARATUS USING THE SAME



(57)Abstract:
PROBLEM TO BE SOLVED: To miniaturize an antenna and broaden the frequency band.
SOLUTION: A loop-like feed-radiating electrode 3 is formed on a base 2 and a passive radiating electrode 4 is disposed near that electrode 3

with a spacing and grounded at one end with the other end opened to perform a resonance operation with a signal fed from the feed-radiating electrode 3 through an electromagnetic coupling. The feed-radiating and passive radiating electrodes 3, 4 make up a double resonance state which facilitates broadening the frequency band. Both radiating electrodes 3, 4 formed on the base 2 constitute an antenna to thereby miniaturize the structure.

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CLAIMS

[Claim(s)]

[Claim 1] In the surface mount mold antenna with which the electric supply radiation electrode with which a signal is supplied from a signal

source of supply is formed in the base Or two or more formation is carried out. the electric supply radiation electrode of loop shape with which opposite arrangement of the open end by the side of the other end was carried out through spacing at the electric supply edge side which receives the signal from a signal source of supply -- 1 -- to a base further The surface mount mold antenna characterized by forming the non-supplied electric power radiation electrode which carries out an electromagnetic coupling to the electric supply radiation electrode which adjoins at least, and makes the double resonance state.

[Claim 2] A non-supplied electric power radiation electrode is the surface mount mold antenna according to claim 1 with which the unpaid radiation electrode of loop shape with which it accomplished with the grand edge where an end side is grounded in a gland, the other end side has accomplished with the open end, and opposite arrangement of the open end was carried out through grand one end and spacing was characterized by 1 or carrying out two or more formation.

[Claim 3] An electric supply radiation electrode and a non-supplied electric power radiation electrode, respectively Resonance actuation of a basic mode, It accomplishes with the configuration of performing resonance actuation of the higher mode with resonance frequency higher than this basic mode. The open end of the electric supply radiation electrode of loop shape, or the non-supplied electric power radiation electrode of loop shape, The surface mount mold antenna according to claim 1 or 2 characterized by adjusting the capacity between the opposite parts of an open end and this open end to the capacity corresponding to the setting resonance frequency of the higher mode with adjustable [of spacing between the parts which counter this open end through a gap].

[Claim 4] It is the surface mount mold antenna according to claim 1, 2, or 3 which a slit is prepared in a field-like pattern, and the electric supply radiation electrode of loop shape or the non-supplied electric power radiation electrode of loop shape is formed in the shape of a loop formation, and was characterized by a slit having 1 times or more of a clinch, or the configuration of crookedness.

[Claim 5] It is the surface mount mold antenna of any one publication of claim 1 characterized by having accomplished the base with the dielectric base and having accomplished this dielectric base with the amount adjustment device of association which adjusts the amount of association of an electric supply radiation electrode and a non-supplied electric power radiation electrode with the dielectric constant of the base concerned thru/or claim 4.

[Claim 6] An electric supply radiation electrode and a non-supplied electric power radiation electrode, respectively Resonance actuation of a basic mode, It accomplishes with the configuration of performing resonance actuation of the higher mode with resonance frequency higher than this basic mode, and a base is accomplished with a dielectric base. This dielectric base with the dielectric constant of the base concerned The open end of the electric supply radiation electrode of loop shape, or the non-supplied electric power radiation electrode of loop shape, The surface mount mold antenna of any one publication of claim 1 characterized by having accomplished with the open end capacity adjustment device which adjusts the capacity between the parts which counter this open end, and adjusts the resonance frequency of the higher mode thru/or claim 5.

[Claim 7] The capacity loading electrode which is arranged through an electric supply radiation electrode and spacing, and has capacity between the electric supply radiation electrodes concerned, Both capacity loading both [inner / inner one side or] which are arranged through a non-supplied electric power radiation electrode and spacing, and have capacity between the non-supplied electric power radiation electrodes concerned are formed. This capacity loading electrode is the surface mount mold antenna of any one publication of claim 1 characterized by having accomplished to the gland with the configuration by which flow connection is made thru/or claim 6.

[Claim 8] The walkie-talkie characterized by forming the surface mount mold antenna of any one publication of claim 1 thru/or claim 7.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the walkie-talkie using the surface mount mold antenna and it which a radiation electrode is formed in a base and grow into it.
[0002]
[Background of the Invention] An example of an antenna is typically shown in drawing 8 (a). what this antenna 30 is proposed as in the Europe public presentation official report EP 0938158A2 -- it is -- a conductor -- it has a line 31 and is constituted. a conductor -- the end side of a line 31 accomplished with the electric supply edge by which signal connection is made to the signal source of supply (transceiver circuit) 32 of walkie-talkies, such as pocket mold telephone, and the other end side has accomplished with the open end. this conductor -- a line 31 is bent and is formed in the shape of a loop formation -- having -- **** -- a conductor -- contiguity arrangement of the open end beta of a line 31 is carried out through spacing at the electric supply edge side alpha.
[0003] This antenna 30 has a return loss property as shown in drawing 8 (b). that is, the signal supplied from the signal source of supply 32 with this antenna 30 -- being based -- a conductor -- it resonates that a line 31 is also for resonance frequency F1 or F2, and antenna actuation is performed. in addition -- here -- a conductor -- the resonance actuation with the lowest resonance frequency is described as a basic mode among two or more resonance frequency of a line 31, and the resonance actuation with resonance frequency higher than the resonance frequency of this basic mode is described as the higher mode.
[0004] this antenna 30 -- a conductor -- by carrying out adjustable control of the capacity between the electric supply edge a line 31 side alpha and an open end beta, the amount of electromagnetic-field association between the electric supply edge side alpha concerned and an open end beta can carry out adjustable, and, thereby, can carry out adjustable control of the resonance frequency F2 of the higher mode, without almost changing the resonance frequency F1 of a basic mode. For this reason, this antenna 30 has the advantage of being easy to adjust the resonance frequency F1 of a basic mode, and the resonance frequency F2 of the higher mode to the frequency of a setup, respectively.
[0005]
[Problem(s) to be Solved by the Invention] The very small antenna for carrying in pocket mold telephone, GPS (Global Positioning System), etc. in recent years is called for. however, the antenna 30 -- a conductor --

what is constituted by the line 31 -- it is -- a conductor -- since it is indispensable conditions to have the die length corresponding to the resonance frequency of a setup of a basic mode, a miniaturization is difficult for a line 31, and it is very difficult to respond to satisfaction at the demand of a miniaturization in recent years.
[0006] moreover, the antenna 30 -- a conductor -- what changes only by the line 31 -- it is -- the conductor -- broadband-ization of a frequency band has the problem of being difficult, only with line 30 simple substance, preventing enlargement of an antenna 30.
[0007] Accomplishing this invention in order to solve the above-mentioned technical problem, the purpose has attained a miniaturization and broadband-ization both to offer the walkie-talkie using an easy surface mount mold antenna and easy it.
[0008]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention is taken as a means to solve said technical problem with the configuration shown below. Namely, the 1st invention is set at the surface mount mold antenna with which the electric supply radiation electrode with which a signal is supplied from a signal source of supply is formed in the base. Or two or more formation is carried out. the electric supply radiation electrode of loop shape with which opposite arrangement of the open end by the side of the other end was carried out through spacing at the electric supply edge side which receives the signal from a signal source of supply -- 1 -- to a base further It is considering as a means to solve said technical problem with the configuration in which the non-supplied electric power radiation electrode which carries out an electromagnetic coupling to the electric supply radiation electrode which adjoins at least, and makes the double resonance state is formed.
[0009] The 2nd invention was equipped with the 1st configuration of invention, the non-supplied electric power radiation electrode was accomplished with the grand edge where an end side is grounded in a gland, the other end side has accomplished with the open end, and the unpaid radiation electrode of loop shape with which opposite arrangement of the open end was carried out through grand one end and spacing is constituted considering 1 or two or more formation being carried out as a description.
[0010] The 3rd invention is equipped with the configuration of the 1st or the 2nd invention. An electric supply radiation electrode and a non-supplied electric power radiation electrode It accomplishes with the configuration of performing resonance actuation of a basic mode, and

resonance actuation of the higher mode with resonance frequency higher than this basic mode, respectively. The open end of the electric supply radiation electrode of loop shape, or the non-supplied electric power radiation electrode of loop shape, The capacity between the opposite parts of an open end and this open end is constituted by adjustable [of spacing between the parts which counter this open end through a gap] considering being adjusted to the capacity corresponding to the setting resonance frequency of the higher mode as a description.

[0011] The 4th invention is equipped with the configuration of the 1st, the 2nd, or the 3rd invention, a slit is prepared in a field-like pattern, the electric supply radiation electrode of loop shape or the non-supplied electric power radiation electrode of loop shape is formed in the shape of a loop formation, and the slit is constituted considering having 1 times or more of a clinch, or the configuration of crookedness as a description.

[0012] It constitutes as a description the 5th invention having been equipped with the configuration of any one invention of the 1st - the 4th invention, having accomplished the base with the dielectric base, and having accomplished this dielectric base with the amount adjustment device of association which adjusts the amount of association of an electric supply radiation electrode and a non-supplied electric power radiation electrode with the dielectric constant of the base concerned.

[0013] The 6th invention is equipped with the configuration of any one invention of the 1st - the 5th invention. An electric supply radiation electrode and a non-supplied electric power radiation electrode It accomplishes with the configuration of performing resonance actuation of a basic mode, and resonance actuation of the higher mode with resonance frequency higher than this basic mode, respectively, and a base is accomplished with a dielectric base. This dielectric base with the dielectric constant of the base concerned It constitutes as a description having accomplished with the open end capacity adjustment device which adjusts the capacity between the parts which counter the open end and this open end of the electric supply radiation electrode of loop shape, or the non-supplied electric power radiation electrode of loop shape, and adjusts the resonance frequency of the higher mode.

[0014] The capacity loading electrode which the 7th invention is equipped with the configuration of any one invention of the 1st - the 6th invention, is arranged through an electric supply radiation electrode and spacing, and has capacity between the electric supply radiation electrodes concerned, Both capacity loading both [inner / inner one side or] which are arranged through a non-supplied electric

power radiation electrode and spacing, and have capacity between the non-supplied electric power radiation electrodes concerned are formed, and this capacity loading electrode is constituted by the gland considering having accomplished with the configuration by which flow connection is made as a description.

[0015] The 8th invention is constituted about the walkie-talkie considering the surface mount mold antenna of any one invention of the 1st - the 7th invention being formed as a description.

[0016] in this invention, since an electric supply radiation electrode is formed in a base and a surface mount mold antenna grows into it, compared with the linear antenna shown in the conventional example, it can be boiled markedly and can be miniaturized. Moreover, the non-supplied electric power radiation electrode which carries out an electromagnetic coupling to the electric supply radiation electrode, and makes the double resonance state near the electric supply radiation electrode to a base is arranged. It is easy to attain broadband-ization of a frequency band by double resonance of this electric supply radiation electrode and a non-supplied electric power radiation electrode. Therefore, it becomes possible [offering an easy antenna and an easy walkie-talkie] to raise a miniaturization and broadband-ization of a frequency band both.

[0017]

[Embodiment of the Invention] Below, the example of an operation gestalt concerning this invention is explained based on a drawing.

[0018] In the walkie-talkie of the example of the 1st operation gestalt, the characteristic surface mount mold antenna is shown to drawing 1 (a) by the typical perspective view. In addition, there are various configurations among the configurations of a walkie-talkie, in this example of the 1st operation gestalt, the walkie-talkie configuration of those other than a surface mount mold antenna may adopt which configuration, and explanation of the walkie-talkie configuration of those other than a surface mount mold antenna is omitted here.

[0019] In this example of the 1st operation gestalt, the characteristic surface mount mold antenna 1 has the rectangular parallelepiped-like dielectric base 2, and the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 of each other are arranged through spacing at top-face 2a of this dielectric base 2. Moreover, the electric supply terminal area 5 and the grand terminal area 6 are installed by front end side 2b of the dielectric base 2 through spacing. Free passage connection of the end side is made at the electric supply radiation electrode 3, an other end side turns to the

base of the dielectric base 2, and the electric supply terminal area 5 is formed. Moreover, free passage connection of the end side is made at the non-supplied electric power radiation electrode 4, an other end side turns to the base of the dielectric base 2, and the grand terminal area 6 is formed.

[0020] Such a surface mount mold antenna 1 is carried in the circuit board of a walkie-talkie. In this case, the dielectric base 2 turns that base to the circuit board, for example, is fixed to the circuit board with solder. Thus, by carrying out the surface mount of the surface mount mold antenna 1 to the helicopter loading site of a setup of the circuit board, signal connection of the electric supply radiation electrode 3 will be made at the signal source of supply (transceiver circuit) 10 of a walkie-talkie through the electric supply terminal area 5 and the matching circuit 8 currently formed in the walkie-talkie. Moreover, the grand terminal area 6 is grounded in a gland. In addition, in case the sign 7 shown in drawing 1 (a) solders the dielectric base 2 to the circuit board, it expresses the electrode for immobilization with which solder is formed.

[0021] The electric supply radiation electrode 3 is shown in the chain line A of drawing 2 , has a return loss property [like], resonates that resonance frequency F1 and F2 are based on the signal supplied through a matching circuit 8 from the signal source of supply 10 of a walkie-talkie, and performs antenna actuation. In this example of the 1st operation gestalt, a slit 12 is formed in the field-like pattern 11 on top-face 2a of the dielectric base 2, this electric supply radiation electrode 3 is formed in loop shape, and opposite arrangement of the electric supply edge side T by which free passage connection is made at the open end K (part where electric field are the strongest) and the electric supply terminal area 5 of this electric supply radiation electrode 3 is carried out through spacing.

[0022] Thereby, capacity has occurred between the open end K side of the electric supply radiation electrode 3, and the electric supply edge side T. By carrying out adjustable [of this capacity], adjustable setting of the resonance frequency F2 of the higher mode can be mostly carried out independently, without almost changing the resonance frequency F1 of the basic mode of the electric supply radiation electrode 3. From this, the open end K of the electric supply radiation electrode 3 and the capacity between electric supply edge side T are adjusted so that the resonance frequency F2 of the higher mode of the electric supply radiation electrode 3 may turn into a frequency of a setup defined beforehand.

[0023] Since the electric supply radiation electrode 3 is formed on the dielectric base 2 not to mention being carried out when adjustment of the capacity between the open end K and electric supply edge side T carries out adjustable [of the opposed face product by the side of / T / an open end K, spacing between electric supply edge side T and an open end K, and an electric supply edge], it is carried out also by carrying out adjustable [of the dielectric constant epsilonr of the dielectric base 2].
[0024] By the way, when the magnitude of the dielectric base 2 is restrained according to the demand of a miniaturization, it is difficult to carry out adjustable [of the opposed face product by the side of / T / the open end K of the electric supply radiation electrode 3, spacing between electric supply edge side T and an open end K, and an electric supply edge] greatly. For this reason, adjustable setting of the capacity between electric supply edge side T may be unable to be greatly carried out to an open end K using the opposed face product by the side of [T] these open ends K, spacing between electric supply edge side T and an open end K, and an electric supply edge.
[0025] On the other hand, since dielectric constant epsilonr of the dielectric base 2 can carry out adjustable regardless of constraint of magnitude, it can carry out adjustable [of the capacity between electric supply edge side T] to an open end K greatly with adjustable [of the dielectric constant epsilonr]. In taking into consideration the miniaturization of the surface mount mold antenna 1 by this, dielectric constant epsilonr of the dielectric base 2 is acting as an important adjustment device for carrying out adjustable setting of the capacity between electric supply edge side T to an open end K. That is, in this example of the 1st operation gestalt, the dielectric base 2 is acting as an open end capacity adjustment device which adjusts the open end K of the electric supply radiation electrode 3, and the capacity between electric supply edge side T, and adjusts the resonance frequency F2 of the higher mode by dielectric constant epsilonr.
[0026] Moreover, electric merit etc. is set up so that the electric supply radiation electrode 3 may serve as the frequency F1 of a setup as which the resonance frequency of a basic mode was determined beforehand.
[0027] In this example of the 1st operation gestalt, as shown in back end side 2c of the dielectric base 2 at drawing 1 (b), contiguity arrangement of the capacity loading electrode 16 is carried out at the electric supply radiation electrode 3. This capacity loading electrode 16 has capacity between the electric supply radiation electrodes 3, and is grounded in a gland. By carrying out adjustable [of the capacity

between this capacity loading electrode 16 and the electric supply radiation electrode 3], the capacity between the electric supply radiation electrode 3 and a gland can carry out adjustable, and can carry out adjustable [of the resonance frequency F1 and F2 of the electric supply radiation electrode 3]. From this, the resonance frequency F1 and F2 of the electric supply radiation electrode 3 is adjusted in this example of the 1st operation gestalt by the capacity adjustment between the capacity loading electrode 16 and the electric supply radiation electrode 3.

[0028] Contiguity arrangement of the non-supplied electric power radiation electrode 4 is carried out through spacing at the electric supply radiation electrode 3, and a signal is supplied by the electromagnetic coupling from the electric supply radiation electrode 3. This non-supplied electric power radiation electrode 4 has a return loss property as shown in the dotted line B of drawing 2 , resonates that resonance frequency f1 and f2 are based on the signal supplied from the electric supply radiation electrode 3 side, and performs antenna actuation. In this example of the 1st operation gestalt, the resonance frequency f1 of the basic mode of the non-supplied electric power radiation electrode 4 is adjusted near the resonance frequency F1 of the basic mode of the electric supply radiation electrode 3. Moreover, the resonance frequency f2 of the higher mode of the non-supplied electric power radiation electrode 4 is adjusted near the resonance frequency F2 of the higher mode of the electric supply radiation electrode 3.

[0029] In this example of the 1st operation gestalt, like the electric supply radiation electrode 3, a slit 14 is formed in the field-like pattern 13 on top-face 2a of the dielectric base 2, the non-supplied electric power radiation electrode 4 is formed in loop shape, and opposite arrangement of grand one end G by which free passage connection is made at the open end P and the grand terminal area 6 of this non-supplied electric power radiation electrode 4 is carried out through spacing. For this reason, also in the non-supplied electric power radiation electrode 4, the resonance frequency f2 of the higher mode is adjusted in the frequency of a setup by adjustment of the capacity between an open end P and grand one end G like the electric supply radiation electrode 3. That is, in this example of the 1st operation gestalt, the dielectric base 2 is acting as an open end capacity adjustment device by the side of no supplying electric power. Moreover, the resonance frequency f1 of the basic mode of the non-supplied electric power radiation electrode 4 is adjusted by electric length etc.

[0030] Furthermore, the capacity loading electrode 17 which has capacity

also between the non-supplied electric power radiation electrodes 4 concerned or near the non-supplied electric power radiation electrode 4 is formed. The capacity loading electrode 17 is formed in back end side 2c of the dielectric base 2, and is grounded in a gland. Like the capacity loading electrode 16 near the electric supply radiation electrode 3, by carrying out adjustable [of the capacity between the non-supplied electric power radiation electrodes 4], adjustable [of the capacity between glands] can be carried out to the non-supplied electric power radiation electrode 4, and the resonance frequency f1 and f2 of the non-supplied electric power radiation electrode 4 can be adjusted also in this capacity loading electrode 17.

[0031] In this example of the 1st operation gestalt, the non-supplied electric power radiation electrode 4 and the electric supply radiation electrode 3 would have the above return loss properties, would be in the double resonance state in both by the side of a basic mode and the higher mode, and are accomplished with the configuration which has a return loss property as shown in the continuous line C of drawing 2 as a surface mount mold antenna 1.

[0032] By the way, when the amount of electromagnetic couplings of the non-supplied electric power radiation electrode 4 and the electric supply radiation electrode 3 is unsuitable, the inconvenient situation of resonance of the non-supplied electric power radiation electrode 4 declining arises, and the good double resonance state cannot be made. In consideration of this, that amount of electromagnetic couplings is adjusted in this example of the 1st operation gestalt that the electromagnetic coupling of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 should be carried out to it being also in the suitable amount of electromagnetic couplings which can make the good double resonance state as shown in drawing 2 . Although there is various technique among the adjustment technique of this amount of electromagnetic couplings, carrying out adjustable setting of the amount of electromagnetic couplings is mentioned by carrying out adjustable [of the spacing of strong A part (refer to drawing 1 (a)) of electric field] as that example among the gaps between the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4. Moreover, there is the technique of adjusting the amount of electromagnetic couplings of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 by dielectric constant epsilonr of the dielectric base 2. In this case, the dielectric base 2 acts as an amount adjustment device of association which adjusts the amount of

electromagnetic couplings of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4.
[0033] by forming the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 in the dielectric base 2, and constituting an antenna, compared with the linear antenna 30 shown in the conventional example, it can be markedly alike and, according to this example of the 1st operation gestalt, the miniaturization of an antenna can be attained. Moreover, in this example of the 1st operation gestalt, the non-supplied electric power radiation electrode 4 is arranged near the electric supply radiation electrode 3, and since it considered as the configuration which makes the double resonance state with the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4, it becomes easy to attain broadband-ization of a frequency band. Therefore, the surface mount mold antenna 1 and a walkie-talkie with easy attaining a miniaturization and broadband-ization of a frequency band both can be offered.
[0034] Furthermore, in this example of the 1st operation gestalt, the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 were accomplished with loop shape, and were considered as the configuration which gives capacity between an open end K and electric supply edge side T (between an open end P and grand one end G). Adjustable setting can be carried out by adjustment of that capacity in the condition of having made the resonance frequency F2 and f2 of the higher mode becoming independent of the resonance frequency F1 and f1 of a basic mode mostly by this configuration. By this, the resonance frequency of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 can be adjusted easily.
[0035] Furthermore, in this example of the 1st operation gestalt, since the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 were formed in the dielectric base 2, it can carry out adjustable [of the open end K of the electric supply radiation electrode 3, the capacity between electric supply edge side T and the open end P of the non-supplied electric power radiation electrode 4, and the capacity between grand one end G] greatly by carrying out adjustable [of the dielectric constant epsilonr of the dielectric base 2]. The resonance frequency F2 and f2 of the higher mode of the electric supply radiation electrode 3 or the non-supplied electric power radiation electrode 4 can be adjusted as even when it is wide range, preventing enlargement without [that is,] changing the configuration and magnitude of the electric supply radiation electrode 3 or the non-supplied electric power radiation electrode 4 from this a lot.

Thereby, the degree of freedom of a design of the surface mount mold antenna 1 can be raised.

[0036] Adjustment of resonance frequency is easy as mentioned above, and moreover, since the amount of electromagnetic couplings of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 is appropriately adjusted by spacing between the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4, and adjustment of dielectric constant epsilonr of the dielectric base 2, it becomes possible to correspond to multi-band-ization which attains a miniaturization and contains a dual band.

[0037] Furthermore, in this example of the 1st operation gestalt, since the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 were made into loop shape, electric field can be shut up in the formation field of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4, and narrow-band-izing and gain degradation of a frequency band which are produced by catching electric field to a gland side can be prevented. Especially the effectiveness is remarkable in a higher-mode side.

[0038] Furthermore, control of the amount of electromagnetic couplings of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 becomes easy by shutting up electric field such.

[0039] Furthermore, when there is a possibility that the body it is considered, for example that is a gland may carry out far and near migration to the surface mount mold antenna 1 and eye ** is [electric field close and] weak, the gain of an antenna may be changed by migration of a body equivalent to the gland. On the other hand, in this example of the 1st operation gestalt, the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 are formed in loop shape, and when electric field close and eye ** becomes strong, the property fluctuation resulting from relative far and near migration of the body to the surface mount mold antenna 1 can be controlled. Thus, it is possible by making the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 into loop shape with the configuration of this example of the 1st operation gestalt to be hard to be influenced of a perimeter environment and to offer the surface mount mold antenna 1 and walkie-talkie which can perform the stable transmission or reception of an electric wave.

[0040] Below, the example of the 2nd operation gestalt is explained. In addition, in explanation of this example of the 2nd operation gestalt,

the same sign is given to the same component as the example of the 1st operation gestalt, and duplication explanation of that intersection is omitted.

[0041] In this example of the 2nd operation gestalt, as shown in drawing 3 (a), it is characterized by forming two or more non-supplied electric power radiation electrodes 4 (4a, 4b). The other configuration is the same as that of the example of the 1st operation gestalt almost.

[0042] In this example of the 2nd operation gestalt, two or more non-supplied electric power radiation electrodes 4a and 4b are arranged with the gestalt which puts the electric supply radiation electrode 3 through spacing, and one side (non-supplied electric power radiation electrode 4b) has accomplished them with loop shape.

[0043] As shown in drawing 3 (b), it also sets for this example of the 2nd operation gestalt. Like the example of the 1st operation gestalt moreover, to back end side 2c of the dielectric base 2 While the capacity loading electrode 16 grounded with capacity in a gland is formed between the electric supply radiation electrodes 3, the capacity loading electrode 17 grounded with capacity in a gland between non-supplied electric power radiation electrode 4b is formed. In addition, of course, the capacity loading electrode 17 which has capacity between non-supplied electric power radiation electrode 4a may be formed if needed.

[0044] In this example of the 2nd operation gestalt, the electric merit of the electric supply radiation electrode 3, the open end K of the electric supply radiation electrode 3 and the capacity between electric supply edge side T, the capacity between the electric supply radiation electrode 3 and the capacity loading electrode 16, etc. were adjusted, and the electric supply radiation electrode 3 is accomplished with the configuration with the return loss property shown in the chain line A of drawing 4 , for example.

[0045] Moreover, in this example of the 2nd operation gestalt, non-supplied electric power radiation electrode 4a has the return loss property shown in the chain line Ba of drawing 4 , and the resonance frequency fa1 of the basic mode of the non-supplied electric power radiation electrode 4 concerned changes with the frequency near the resonance frequency F2 of the higher mode of the electric supply radiation electrode 3. Moreover, non-supplied electric power radiation electrode 4b of loop shape has the return loss property shown in the chain line Bb of drawing 4 , and the resonance frequency fb1 of the basic mode of the non-supplied electric power radiation electrode 4 concerned changes with the frequency near the resonance frequency F1 of

the basic mode of the electric supply radiation electrode 3.
[0046] The amount of electromagnetic couplings of non-supplied electric power radiation electrode 4a and the electric supply radiation electrode 3 and the amount of electromagnetic couplings of non-supplied electric power radiation electrode 4b and the electric supply radiation electrode 3 are adjusted by dielectric constant epsilonr of the dielectric base 2, spacing between the radiation electrode 3 and 4, etc., respectively so that the electromagnetic coupling of the non-supplied [these] electric power radiation electrodes 4a and 4b and the electric supply radiation electrode 3 may be carried out and the good double resonance state can be made. By this, the basic mode of the electric supply radiation electrode 3 and the basic mode of non-supplied electric power radiation electrode 4b make the double resonance state, and the higher mode of the electric supply radiation electrode 3 and the basic mode of non-supplied electric power radiation electrode 4a make the double resonance state, and the surface mount mold antenna 1 shown in this example of the 2nd operation gestalt has the return loss property as shown in the continuous line C of drawing 4 .
[0047] Also in this example of the 2nd operation gestalt, the same outstanding effectiveness as the example of the 1st operation gestalt can be done so. In this example of the 2nd operation gestalt, since two or more non-supplied electric power radiation electrodes 4 were formed, it especially becomes easy to respond to multi-band-ization.
[0048] Below, the example of the 3rd operation gestalt is explained. In addition, in explanation of this example of the 3rd operation gestalt, the same sign is given to the same component as said each example of an operation gestalt, and duplication explanation of that intersection is omitted.
[0049] It being characteristic in this example of the 3rd operation gestalt is that two or more electric supply radiation electrodes 3 (3a, 3b) are formed in the dielectric base 2, as shown in drawing 5 . The other configuration is the same as that of the example of the 2nd operation gestalt almost.
[0050] In this example of the 3rd operation gestalt, two or more electric supply radiation electrodes 3a and 3b are installed through spacing, and the one side of these electric supply radiation electrodes 3a and 3b (electric supply radiation electrode 3b) has accomplished them with loop shape. The non-supplied electric power radiation electrodes 4a and 4b are formed with the gestalt which puts such electric supply radiation electrodes 3a and 3b through spacing.
[0051] The electric supply radiation electrode 3 side branches to two,

and free passage connection of the electric supply terminal area 5 is made respectively at the electric supply radiation electrodes 3a and 3b. Thereby, signal connection of the electric supply radiation electrodes 3a and 3b is made through the matching circuit 8 of a walkie-talkie at the same signal source of supply 10 through the common electric supply terminal area 5.

[0052] In this example of the 3rd operation gestalt, electric supply radiation electrode 3a has a return loss property as shown in the dotted line Aa of drawing 6 , and the resonance frequency of a basic mode is adjusted to the frequency Fa1. Moreover, electric supply radiation electrode 3b of loop shape has a return loss property as shown in the chain line Ab, and the resonance frequency of a basic mode is adjusted to a frequency Fb1, and the resonance frequency of the higher mode is adjusted to the frequency Fb2. Furthermore, non-supplied electric power radiation electrode 4a has a return loss property as shown in the chain line Ba, and the resonance frequency of a basic mode is adjusted to the frequency fa1. Non-supplied electric power radiation electrode 4b of loop shape has a return loss property as shown in a dotted line Bb, the resonance frequency of a basic mode is adjusted to a frequency fb1, and the resonance frequency of the higher mode is adjusted to the frequency fb2.

[0053] Also in this example of the 3rd operation gestalt, like each 1st and 2nd example of an operation gestalt, the amount of electromagnetic couplings of these electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 is adjusted so that the electric supply radiation electrode 3 (3a, 3b) and the non-supplied electric power radiation electrode 4 (4a, 4b) may be in the good double resonance state. Thereby, the surface mount mold antenna 1 has the return loss property as shown in the continuous line C of drawing 6 .

[0054] Also in this example of the 3rd operation gestalt, the same outstanding effectiveness as said each example of an operation gestalt can be done so. Moreover, since two or more electric supply radiation electrodes 3 were formed, multi-band-ization becomes still easier. For example, the frequency range D1 shown in drawing 6 corresponds to GSM (Global System for Mobile communication). A frequency range D2 corresponds to DCS (Digital Celular System). A frequency range D3 corresponds to PCS (Personal Communication System). So that a frequency range D4 may correspond to W-CDMA (Wideband-Code Division Multiple Access) and a frequency range D5 may correspond to Bluetooth By setting up each resonance frequency of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4, it can

respond to five communication system.
[0055] Moreover, although we are anxious about these electric supply radiation electrodes 3a and 3b carrying out a mutual intervention in this example of the 3rd operation gestalt since two or more electric supply radiation electrodes 3 were formed the electric field in the electric supply radiation electrode 3 (3b) of the loop shape since the one side of these electric supply radiation electrodes 3a and 3b has accomplished with loop shape -- it originates in shutting up and the mutual intervention of these electric supply radiation electrodes 3a and 3b can be controlled.
[0056] In this example of the 3rd operation gestalt like said each example of an operation gestalt in addition, to back end side 2c of the dielectric base 2 May form the capacity loading electrode 16 which has capacity between the electric supply radiation electrodes 3, and the capacity loading electrode 17 which has capacity between the non-supplied electric power radiation electrodes 4, and moreover -- there are no capacity loading electrodes 16 and 17 of these -- ** -- when the frequency regulation of the electric supply radiation electrode 3 or the non-supplied electric power radiation electrode 4 accomplishes, it is not necessary to form these capacity loading electrodes 16 and 17
[0057] In addition, this invention is not limited to each above-mentioned example of an operation gestalt, and can take the gestalt of various operations. For example, in such a case, since it ends even if it does not control resonance frequency f2 of the higher mode of the non-supplied electric power radiation electrode 4 in not using the higher mode of the non-supplied electric power radiation electrode 4, as shown in drawing 7 (a), it is not necessary to make the non-supplied electric power radiation electrode 4 into loop shape.
[0058] Moreover, although only the one side of the non-supplied electric power radiation electrodes 4a and 4b had accomplished with loop shape in the 2nd and 3rd example of an operation gestalt, it is good also considering both as loop shape. Moreover, although only the one side of the electric supply radiation electrodes 3a and 3b had accomplished with loop shape in the example of the 3rd operation gestalt, it is good also considering both as loop shape. Moreover, the electric supply radiation electrode 3 and three non-supplied electric power radiation electrodes 4 or more may be formed, and the number of formation is not limited.
[0059] Furthermore, in the 1st and 2nd example of an operation gestalt, although the capacity loading electrodes 16 and 17 were formed, even if it does not form the capacity loading electrodes 16 and 17, when it can perform easily performing frequency regulation of the electric supply

radiation electrode 3 or the non-supplied electric power radiation electrode 4, the capacity loading electrodes 16 and 17 may be omitted.
[0060] Furthermore, when capacity between the capacity loading electrode 16 and the electric supply radiation electrode 3 or capacity between the capacity loading electrode 17 and the non-supplied electric power radiation electrode 4 is made larger than each above-mentioned example of an operation gestalt, as shown in drawing 7 (b), you may form. In this case, the width of face of the capacity loading electrode 17 is expanded rather than each above-mentioned example of an operation gestalt, and elongation formation of some non-supplied electric power radiation electrodes 4 is carried out towards the capacity loading electrode 17, and it is formed so that the opposed face product of the capacity loading electrode 17 and the non-supplied electric power radiation electrode 4 may be increased.
[0061] Furthermore, although the electric supply terminal area 5 accomplished with the configuration where the electric supply radiation electrode 3 side branched and signal connection of two or more electric supply radiation electrodes 3 was made through the common electric supply terminal area 5 in the example of the 3rd operation gestalt at the same signal source of supply 10 As shown in drawing 7 (c), to for example, the circuit board 20 in which the surface mount mold antenna 1 carries out a surface mount When the pattern 21 for electric supply for making the same signal source of supply 10 make signal connection of two or more electric supply radiation electrodes 3 is formed, it is good also as a configuration which forms the electric supply terminal area 5 only for [electric supply radiation electrode 3] each in the dielectric base 2, respectively.
[0062] Furthermore, each resonance frequency of the electric supply radiation electrode 3 and the non-supplied electric power radiation electrode 4 may be set up suitably, and it is not limited to the example shown in drawing 2 , drawing 4 , or drawing 6 .
[0063]
[Effect of the Invention] compared with the linear antenna which according to this invention was shown in the conventional example since the non-supplied electric power radiation electrode which makes the double resonance state with an electric supply radiation electrode was formed while the electric supply radiation electrode of loop shape was formed in the base, it becomes easy for it to be able to be markedly alike, to be able to miniaturize upwards and to attain broadband-ization of a frequency band. The surface mount mold antenna and walkie-talkie with which it becomes easy to attain a miniaturization and broadband-

ization of a frequency band both by this can be offered.
[0064] If a non-supplied electric power radiation electrode is one of loop shape and those which have been accomplished, also not only in an electric supply radiation electrode but in a non-supplied electric power radiation electrode, the resonance frequency of the higher mode can be easily adjusted by adjusting the capacity between an open end and grand one end, without changing most resonance frequency of a basic mode. Thereby, it becomes easy to adjust the resonance frequency of each basic mode of an electric supply radiation electrode and a non-supplied electric power radiation electrode and the higher mode, and multi-band-ization can be easily attained so that it may become being also in the frequency band corresponding to two or more communication system transmission of an electric wave, or receivable.
[0065] Moreover, since an electric supply radiation electrode or a non-supplied electric power radiation electrode is loop shape, electric field can be shut up in the formation field of an electric supply radiation electrode and a non-supplied electric power radiation electrode. Narrow-band-izing and gain degradation of a frequency band which are based on electric field being caught at a gland side by this can be prevented. Although it is easy to generate especially narrow-band-izing and gain degradation of such a frequency band in a higher-mode side, the problem generating can be controlled by considering as loop shape.
[0066] Furthermore, control of the amount of electromagnetic couplings of an electric supply radiation electrode and a non-supplied electric power radiation electrode becomes easy as loop shape by confining electric field in the formation field of an electric supply radiation electrode and a non-supplied electric power radiation electrode.
[0067] Furthermore, when two or more electric supply radiation electrodes are prepared, there is a possibility that the electric supply radiation inter-electrode mutual intervention of these plurality may arise, but since electric field are shut up in the electric supply radiation electrode of loop shape, it is possible to be able to control the mutual intervention with the electric supply radiation electrode of the loop shape, and to raise the independence of resonance actuation of each electric supply radiation electrode.
[0068] Furthermore, since electric field can be shut up, when the body it is considered that is a gland carries out far and near migration to a surface mount mold antenna, for example, the effectiveness of being hard to be influenced of external and becoming can be done so so that it may say that the property fluctuation resulting from migration of the body

can be controlled.
[0069] if it is in some which a slit is prepared in a field-like pattern and formed in loop shape -- a line -- compared with the case where loop shape is formed with a pattern, the area of a radiation electrode is expandable.
[0070] An electric supply radiation electrode and the non-supplied electric power radiation inter-electrode amount of electromagnetic couplings can be adjusted by a base's accomplishing with a dielectric base, and carrying out adjustable [of the dielectric constant of a dielectric base] in addition to adjusting spacing of an electric supply radiation electrode and a non-supplied electric power radiation electrode, if it is in some which this dielectric base is using as the amount adjustment device of association. Thereby, preventing enlargement of an antenna, an electric supply radiation electrode and the non-supplied electric power radiation inter-electrode amount of electromagnetic couplings can be adjusted so that an electric supply radiation electrode and a non-supplied electric power radiation electrode can make the good double resonance state which can attain broadband-ization.
[0071] The resonance frequency of the higher mode can be adjusted easily, controlling enlargement, if it is in some to which the open end of an electric supply radiation electrode, that to which the capacity between electric supply edge sides is adjusted with the dielectric constant of a dielectric base and the open end of a non-supplied electric power radiation electrode, and the capacity between grand edge sides are adjusted with the dielectric constant of a dielectric base without [that is,] changing most of the magnitude and the configuration of an electric-supply radiation electrode or a non-supplied electric power radiation electrode. Moreover, the adjustable adjustable range of the resonance frequency of the higher mode can be extended.
[0072] If the capacity loading electrode grounded in a gland is one of those which are arranged through capacity near the electric supply radiation electrode or the non-supplied electric power radiation electrode By carrying out adjustable [of the capacity between an electric supply radiation electrode or a non-supplied electric power radiation electrode, and a capacity loading electrode], the capacity between an electric supply radiation electrode or a non-supplied electric power radiation electrode, and a gland can carry out adjustable, and the resonance frequency of an electric supply radiation electrode or a non-supplied electric power radiation electrode can be adjusted. This can make resonance frequency much more easy to adjust.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the model Fig. having shown the example of a configuration of a characteristic surface mount mold antenna by the typical perspective view in the example of the 1st operation gestalt.
[Drawing 2] It is the graph which shows an example of the return loss property which the surface mount mold antenna shown in drawing 1 has.
[Drawing 3] It is the model Fig. having shown the example of a configuration of a characteristic surface mount mold antenna by the typical perspective view in the example of the 2nd operation gestalt.
[Drawing 4] It is the graph which shows an example of the return loss property which the surface mount mold antenna shown in drawing 3 has.
[Drawing 5] It is the model Fig. having shown the example of a configuration of a characteristic surface mount mold antenna by the typical perspective view in the example of the 3rd operation gestalt.
[Drawing 6] It is the graph which shows an example of the return loss property which the surface mount mold antenna shown in drawing 5 has.
[Drawing 7] It is drawing for explaining the other examples of an operation gestalt.
[Drawing 8] It is the explanatory view showing the conventional example.
[Description of Notations]
1 Surface Mount Mold Antenna
2 Dielectric Base
3 Electric Supply Radiation Electrode
4 Non-Supplied Electric Power Radiation Electrode
10 Signal Source of Supply
11 13 Field-like pattern

12 14 Slit
16 17 Capacity loading electrode

[Translation done.]

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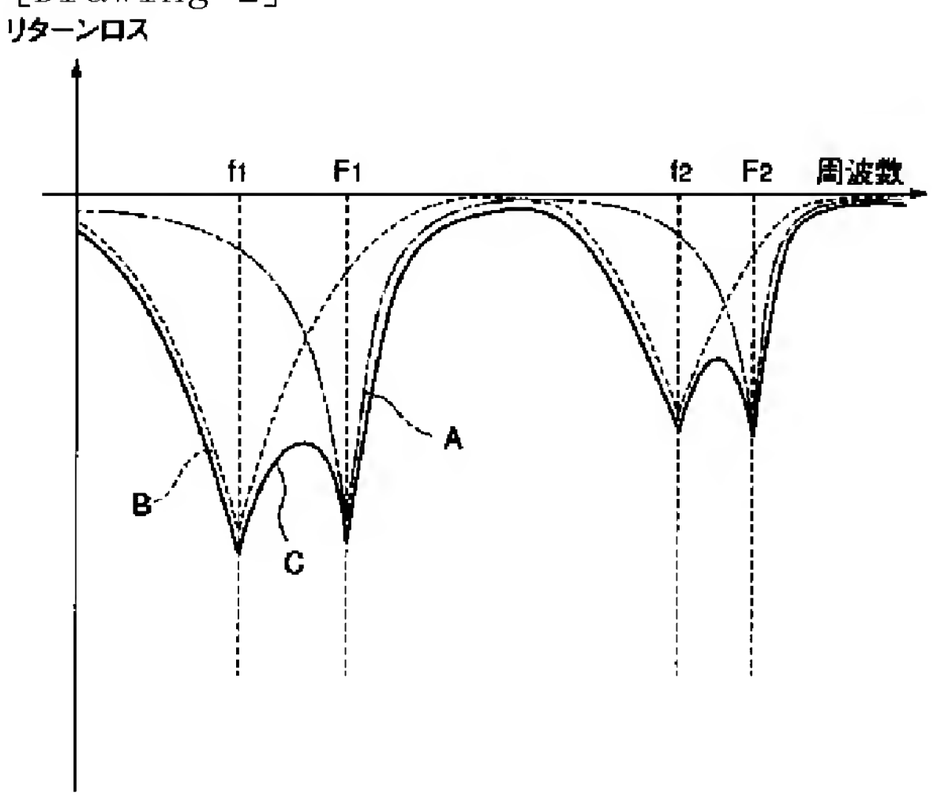
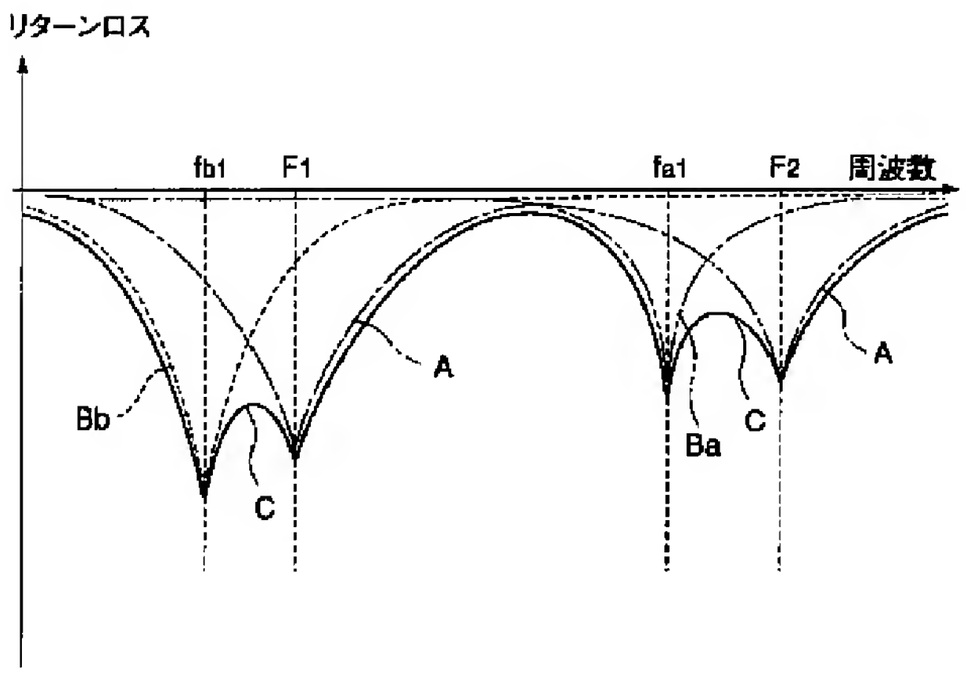
DRAWINGS

[Drawing 2]

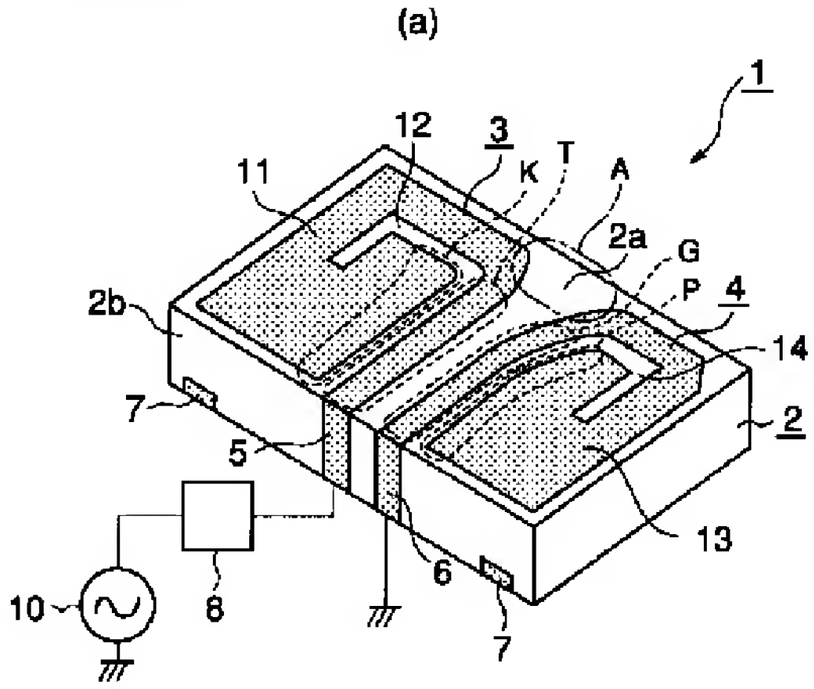


[Drawing 4]



[Drawing 1]

(a)



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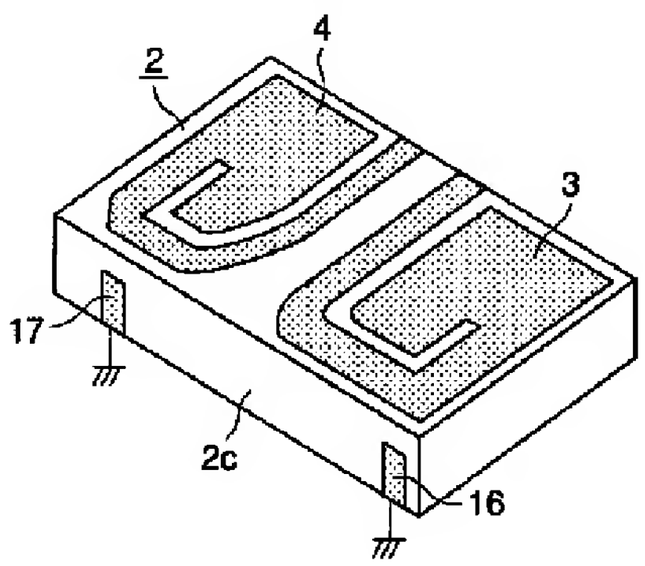
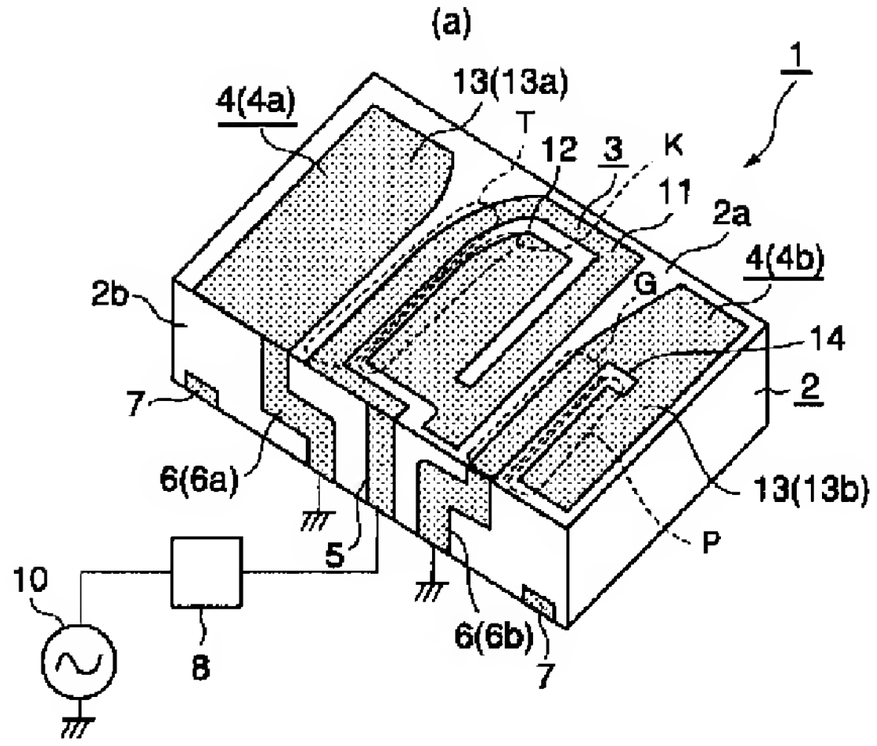


[Drawing 3]

(a)



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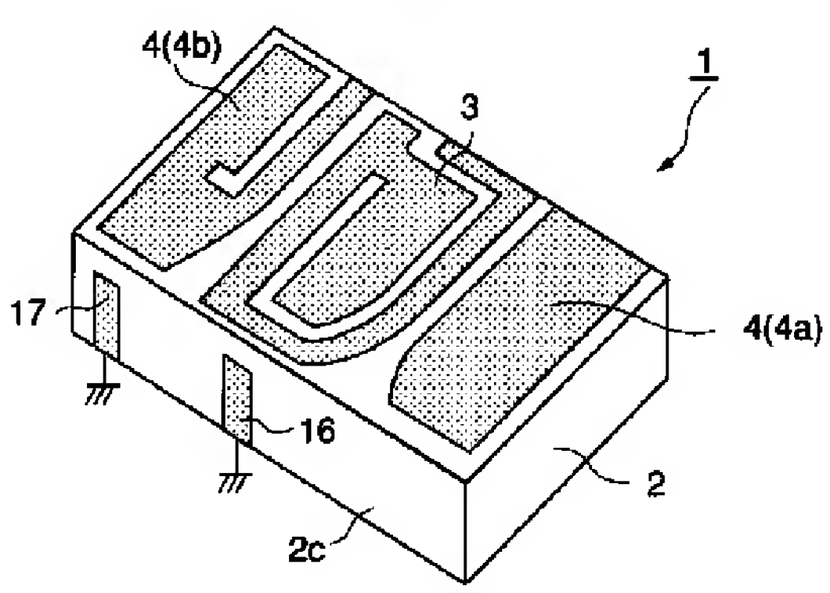
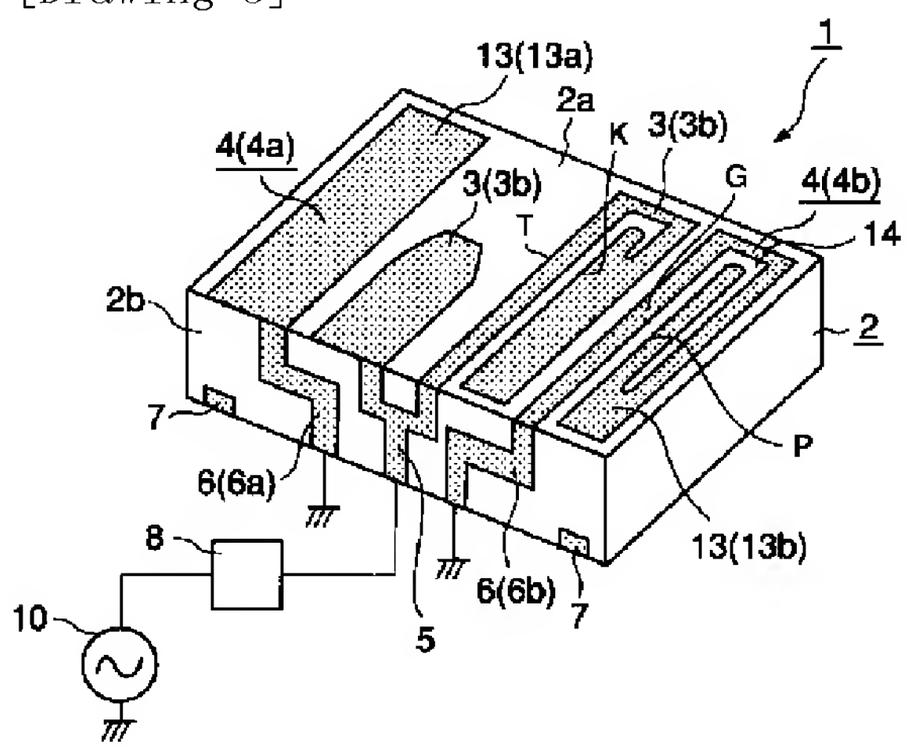
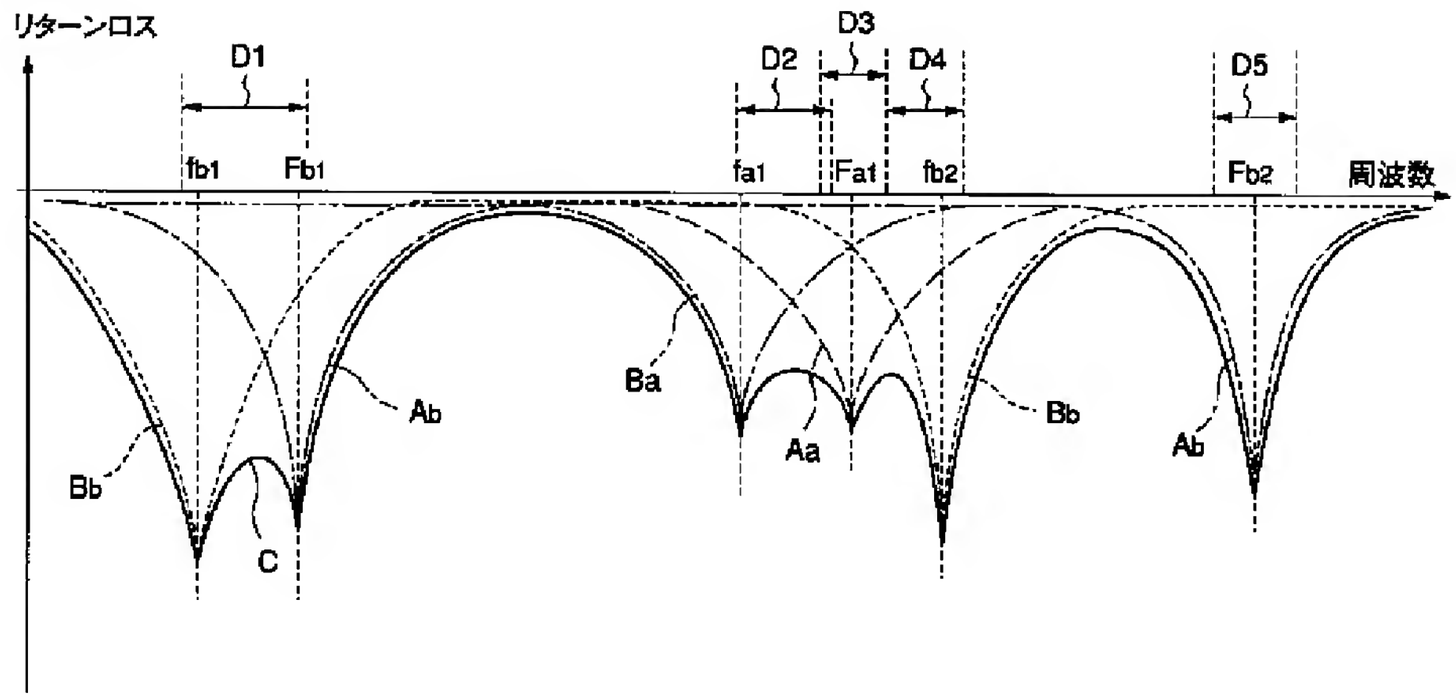


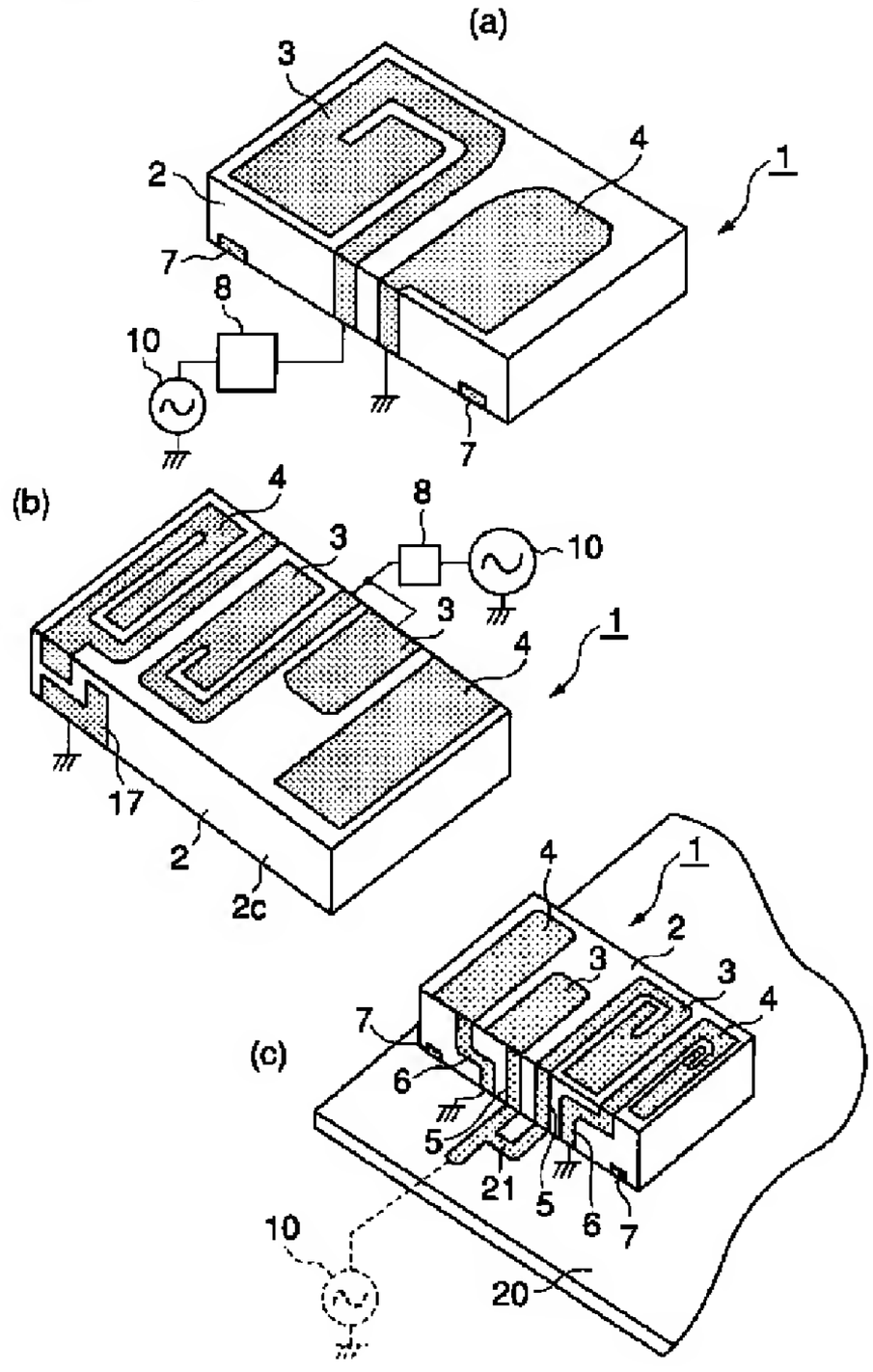
[Drawing 5]



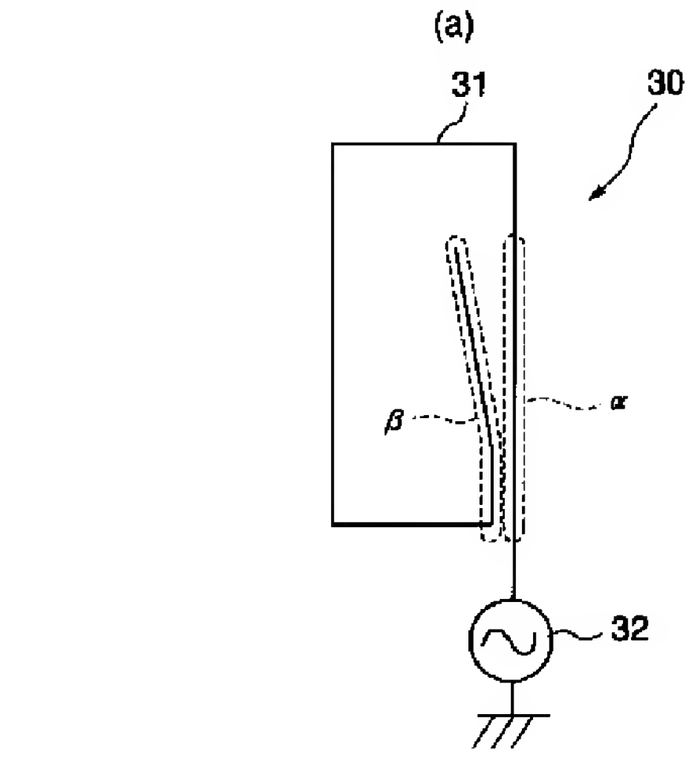
[Drawing 6]



[Drawing 7]



[Drawing 8]



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	1/24			1/24	Ｚ　５Ｊ０４７
	1/36			1/36	
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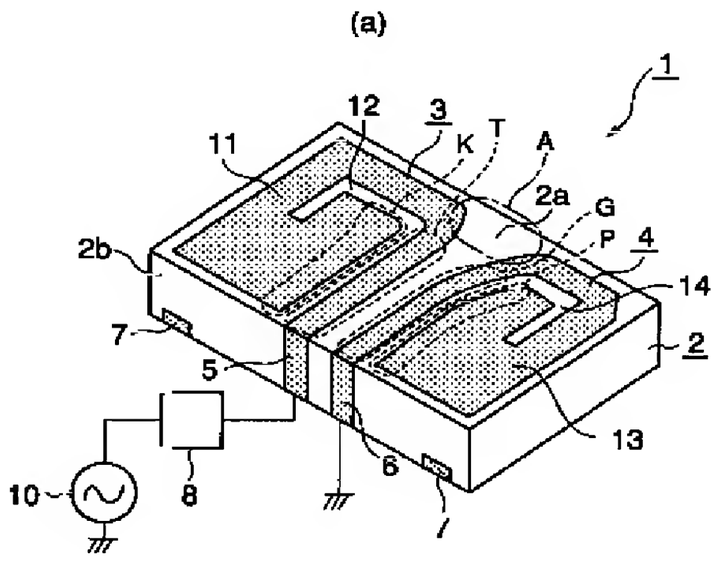
最終頁に続く

(54)【発明の名称】　表面実装型アンテナおよびそれを用いた無線機

(57)【要約】
【課題】　アンテナの小型化および周波数帯域の広帯域化を図る。
【解決手段】　基体２にループ形状の給電放射電極３を形成すると共に、この給電放射電極３と間隔を介して無給電放射電極４を近接配置する。無給電放射電極４は一端側がグランドに接地され、他端側が開放端と成しているものであり、給電放射電極３から電磁結合により信号が供給されて共振動作を行う。給電放射電極３と無給電放射電極４は複共振状態を作り出す。この複共振により、周波数帯域の広帯域化を容易に図ることができる。また、基体２に給電放射電極３と無給電放射電極４を形成してアンテナを構成することにより、小型化を図ることができる。

(a)



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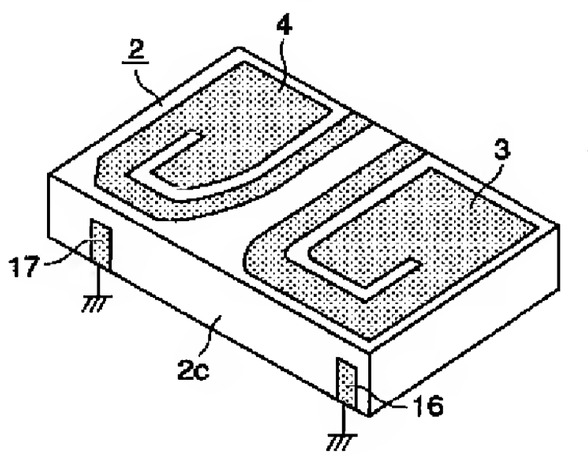


【特許請求の範囲】
【請求項１】　信号供給源から信号が供給される給電放射電極が基体に形成されている表面実装型アンテナにおいて、信号供給源からの信号を受ける給電端部側に他端側の開放端が間隔を介して対向配置されたループ形状の給電放射電極が１あるいは複数形成されており、さらに基体には、少なくとも隣接する給電放射電極と電磁結合して複共振状態を作り出す無給電放射電極が形成されていることを特徴とした表面実装型アンテナ。
【請求項２】　無給電放射電極は、一端側がグランドに接地されるグランド端と成し、他端側が開放端と成しており、開放端がグランド端側と間隔を介して対向配置されたループ形状の無給放射電極が１あるいは複数形成されていることを特徴とした請求項１記載の表面実装型アンテナ。
【請求項３】　給電放射電極と無給電放射電極は、それぞれ、基本モードの共振動作と、この基本モードよりも共振周波数が高い高次モードの共振動作とを行う構成と成し、ループ形状の給電放射電極又はループ形状の無給電放射電極の開放端と、該開放端に間隙を介して対向する部位との間の間隔の可変によって、開放端と該開放端の対向部位との間の容量が高次モードの設定共振周波数に対応した容量に調整されていることを特徴とした請求項１又は請求項２記載の表面実装型アンテナ。
【請求項４】　ループ形状の給電放射電極又はループ形状の無給電放射電極は、面状パターンにスリットが設けられてループ状に形成されており、スリットは、１回以上の折り返し、あるいは、屈曲の形状を有することを特徴とした請求項１又は請求項２又は請求項３記載の表面実装型アンテナ。
【請求項５】　基体は誘電体基体と成し、この誘電体基体は当該基体の誘電率によって給電放射電極と無給電放射電極の結合量を調整する結合量調整手段と成していることを特徴とした請求項１乃至請求項４の何れか１つに記載の表面実装型アンテナ。
【請求項６】　給電放射電極と無給電放射電極は、それぞれ、基本モードの共振動作と、この基本モードよりも共振周波数が高い高次モードの共振動作とを行う構成と成し、基体は誘電体基体と成し、この誘電体基体は当該基体の誘電率によって、ループ形状の給電放射電極又はループ形状の無給電放射電極の開放端と、該開放端に対向する部位との間の容量を調整して高次モードの共振周波数を調整する開放端容量調整手段と成していることを特徴とした請求項１乃至請求項５の何れか１つに記載の表面実装型アンテナ。
【請求項７】　給電放射電極と間隔を介して配置されて当該給電放射電極との間に容量を持つ容量装荷電極と、無給電放射電極と間隔を介して配置されて当該無給電放射電極との間に容量を持つ容量装荷電極とのうちの一方あるいは両方が形成されており、この容量装荷電極はグランドに導通接続される構成と成していることを特徴とした請求項１乃至請求項６の何れか１つに記載の表面実装型アンテナ。
【請求項８】　請求項１乃至請求項７の何れか１つに記載の表面実装型アンテナが設けられていることを特徴とした無線機。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、基体に放射電極が形成されて成る表面実装型アンテナおよびそれを用いた無線機に関するものである。
【０００２】
【背景技術】図８（ａ）にはアンテナの一例が模式的に示されている。このアンテナ３０は欧州公開公報ＥＰ０９３８１５８Ａ２にて提案されているものであり、導体線３１を有して構成されている。導体線３１の一端側は例えば携帯型電話機等の無線機の信号供給源（送受信回路）３２に信号接続される給電端部と成し、他端側は開放端と成している。この導体線３１は折り曲げられてループ状に形成されており、導体線３１の開放端βは給電端部側αに間隔を介して近接配置されている。
【０００３】このアンテナ３０は、図８（ｂ）に示されるようなリターンロス特性を有するものである。つまり、このアンテナ３０では、信号供給源３２から供給される信号に基づいて、導体線３１が共振周波数Ｆ１やＦ２でもって共振してアンテナ動作を行う。なお、ここでは、導体線３１の複数の共振周波数のうち、最も低い共振周波数での共振動作を基本モードと述べ、この基本モードの共振周波数よりも高い共振周波数での共振動作を高次モードと述べる。
【０００４】このアンテナ３０では、導体線３１の給電端部側αと開放端β間の容量を可変制御することによって当該給電端部側αと開放端β間の電磁界結合量が可変し、これにより、基本モードの共振周波数Ｆ１を殆ど変化させずに、高次モードの共振周波数Ｆ２を可変制御することができる。このため、このアンテナ３０は、基本モードの共振周波数Ｆ１と高次モードの共振周波数Ｆ２をそれぞれ設定の周波数に調整し易いという利点を有する。
【０００５】
【発明が解決しようとする課題】近年、携帯型電話機やＧＰＳ（Global Positioning System）等に搭載するための非常に小型なアンテナが求められている。しかしながら、アンテナ３０は導体線３１により構成されるものであり、導体線３１は基本モードの設定の共振周波数に対応した長さを持つことが必須の条件であることから、小型化が難しく、近年の小型化の要求に満足に応えることが非常に困難である。
【０００６】また、アンテナ３０は導体線３１だけで成るものであり、その導体線３０単体のみでは、アンテナ

３０の大型化を防止しつつ、周波数帯域の広帯域化は難しいという問題がある。

【０００７】本発明は上記課題を解決するために成されたものであり、その目的は、小型化と広帯域化を両方共に達成することが容易な表面実装型アンテナおよびそれを用いた無線機を提供することにある。

【０００８】

【課題を解決するための手段】上記目的を達成するために、この発明は次に示す構成をもって前記課題を解決する手段としている。すなわち、第１の発明は、信号供給源から信号が供給される給電放射電極が基体に形成されている表面実装型アンテナにおいて、信号供給源からの信号を受ける給電端部側に他端側の開放端が間隔を介して対向配置されたループ形状の給電放射電極が１あるいは複数形成されており、さらに基体には、少なくとも隣接する給電放射電極と電磁結合して複共振状態を作り出す無給電放射電極が形成されている構成をもって前記課題を解決する手段としている。

【０００９】第２の発明は、第１の発明の構成を備え、無給電放射電極は、一端側がグランドに接地されるグランド端と成し、他端側が開放端と成しており、開放端がグランド端側と間隔を介して対向配置されたループ形状の無給放射電極が１あるいは複数形成されていることを特徴として構成されている。

【００１０】第３の発明は、第１又は第２の発明の構成を備え、給電放射電極と無給電放射電極は、それぞれ、基本モードの共振動作と、この基本モードよりも共振周波数が高い高次モードの共振動作とを行う構成と成し、ループ形状の給電放射電極又はループ形状の無給電放射電極の開放端と、該開放端に間隙を介して対向する部位との間の間隔の可変によって、開放端と該開放端の対向部位との間の容量が高次モードの設定共振周波数に対応した容量に調整されていることを特徴として構成されている。

【００１１】第４の発明は、第１又は第２又は第３の発明の構成を備え、ループ形状の給電放射電極又はループ形状の無給電放射電極は、面状パターンにスリットが設けられてループ状に形成されており、スリットは、１回以上の折り返し、あるいは、屈曲の形状を有することを特徴として構成されている。

【００１２】第５の発明は、第１～第４の発明の何れか１つの発明の構成を備え、基体は誘電体基体と成し、この誘電体基体は当該基体の誘電率によって給電放射電極と無給電放射電極の結合量を調整する結合量調整手段と成していることを特徴として構成されている。

【００１３】第６の発明は、第１～第５の発明の何れか１つの発明の構成を備え、給電放射電極と無給電放射電極は、それぞれ、基本モードの共振動作と、この基本モードよりも共振周波数が高い高次モードの共振動作とを行う構成と成し、基体は誘電体基体と成し、この誘電体基体は当該基体の誘電率によって、ループ形状の給電放射電極又はループ形状の無給電放射電極の開放端と、該開放端に対向する部位との間の容量を調整して高次モードの共振周波数を調整する開放端容量調整手段と成していることを特徴として構成されている。

【００１４】第７の発明は、第１～第６の発明の何れか１つの発明の構成を備え、給電放射電極と間隔を介して配置されて当該給電放射電極との間に容量を持つ容量装荷電極と、無給電放射電極と間隔を介して配置されて当該無給電放射電極との間に容量を持つ容量装荷電極とのうちの一方あるいは両方が形成されており、この容量装荷電極はグランドに導通接続される構成と成していることを特徴として構成されている。

【００１５】第８の発明は、無線機に関し、第１～第７の発明の何れか１つの発明の表面実装型アンテナが設けられていることを特徴として構成されている。

【００１６】この発明では、表面実装型アンテナは基体に給電放射電極が形成されて成るものであることから、従来例に示した線状のアンテナに比べて、格段に小型化することができる。また、基体には、給電放射電極の近傍に、その給電放射電極と電磁結合して複共振状態を作り出す無給電放射電極が配置されている。この給電放射電極と無給電放射電極の複共振によって、周波数帯域の広帯域化を図ることが容易である。よって、小型化、および、周波数帯域の広帯域化を両方共に向上させることが容易なアンテナおよび無線機を提供することが可能となる。

【００１７】

【発明の実施の形態】以下に、この発明に係る実施形態例を図面に基づいて説明する。

【００１８】図１（ａ）には第１実施形態例の無線機において特徴的な表面実装型アンテナが模式的な斜視図により示されている。なお、無線機の構成には様々な構成があり、この第１実施形態例では、表面実装型アンテナ以外の無線機構成は何れの構成を採用してもよく、ここでは、表面実装型アンテナ以外の無線機構成の説明は省略する。

【００１９】この第１実施形態例において特徴的な表面実装型アンテナ１は直方体状の誘電体基体２を有し、この誘電体基体２の上面２ａには給電放射電極３および無給電放射電極４が互いに間隔を介して配置されている。また、誘電体基体２の前端面２ｂには給電端子部５とグランド端子部６が間隔を介して並設されている。給電端子部５は一端側が給電放射電極３に連通接続され、他端側が誘電体基体２の底面に回り込んで形成されている。また、グランド端子部６は一端側が無給電放射電極４に連通接続され、他端側が誘電体基体２の底面に回り込んで形成されている。

【００２０】このような表面実装型アンテナ１は無線機の例えば回路基板に搭載される。この場合、誘電体基体

２はその底面を回路基板に向けて、例えば半田により回路基板に固定される。このように表面実装型アンテナ１が回路基板の設定の搭載位置に表面実装されることにより、給電放射電極３は、給電端子部５と、無線機に形成されている整合回路８とを介して無線機の信号供給源（送受信回路）１０に信号接続されることとなる。また、グランド端子部６はグランドに接地される。なお、図１（ａ）に示す符号７は誘電体基体２を回路基板に半田付けする際に半田が形成される固定用電極を表している。

【００２１】給電放射電極３は、例えば図２の鎖線Ａに示されようなリターンロス特性を持ち、無線機の信号供給源１０から整合回路８を介して供給される信号に基づいて、共振周波数Ｆ1やＦ2でもって共振してアンテナ動作を行う。この第１実施形態例では、この給電放射電極３は、誘電体基体２の上面２ａ上の面状パターン１１にスリット１２が設けられてループ形状に形成されており、この給電放射電極３の開放端Ｋ（電界が最も強い部位）と、給電端子部５に連通接続されている給電端部側Ｔとが間隔を介して対向配置されている。

【００２２】これにより、給電放射電極３の開放端Ｋと給電端部側Ｔとの間には容量が発生している。この容量を可変することにより、給電放射電極３の基本モードの共振周波数Ｆ1を殆ど変化させずに高次モードの共振周波数Ｆ2をほぼ独立して可変調整することができる。このことから、給電放射電極３の開放端Ｋと給電端部側Ｔ間の容量は、給電放射電極３の高次モードの共振周波数Ｆ2が予め定められた設定の周波数となるように調整されている。

【００２３】その開放端Ｋと給電端部側Ｔ間の容量の調整は、開放端Ｋと給電端部側Ｔ間の間隔や、開放端Ｋと給電端部側Ｔとの対向面積を可変することによって行われているのはもちろんのこと、給電放射電極３は誘電体基体２上に形成されていることから、誘電体基体２の誘電率ε_rを可変することによっても行われている。

【００２４】ところで、小型化の要求に応じて誘電体基体２の大きさが制約されている場合には、給電放射電極３の開放端Ｋと給電端部側Ｔ間の間隔や、開放端Ｋと給電端部側Ｔとの対向面積を大きく可変することは難しい。このため、それら開放端Ｋと給電端部側Ｔ間の間隔や、開放端Ｋと給電端部側Ｔとの対向面積を利用して、開放端Ｋと給電端部側Ｔ間の容量を大きく可変調整することができない場合がある。

【００２５】これに対して、誘電体基体２の誘電率ε_rは、大きさの制約に関係なく可変することが可能であるから、その誘電率ε_rの可変によって開放端Ｋと給電端部側Ｔ間の容量を大きく可変することができる。このことにより、表面実装型アンテナ１の小型化を考慮する場合には、誘電体基体２の誘電率ε_rは開放端Ｋと給電端部側Ｔ間の容量を可変調整するための重要な調整手段として作用している。つまり、この第１実施形態例では、誘電体基体２は誘電率ε_rによって給電放射電極３の開放端Ｋと給電端部側Ｔ間の容量を調整して高次モードの共振周波数Ｆ2を調整する開放端容量調整手段として作用している。

【００２６】また、給電放射電極３は、基本モードの共振周波数が予め定められた設定の周波数Ｆ1となるように、電気長などが設定されている。

【００２７】この第１実施形態例では、誘電体基体２の後端面２ｃには、図１（ｂ）に示されるように、容量装荷電極１６が給電放射電極３に近接配置されている。この容量装荷電極１６は給電放射電極３との間に容量を持ち、かつ、グランドに接地されるものである。この容量装荷電極１６と給電放射電極３間の容量を可変することにより、給電放射電極３とグランド間の容量が可変して、給電放射電極３の共振周波数Ｆ1，Ｆ2を可変することができる。このことから、この第１実施形態例では、給電放射電極３の共振周波数Ｆ1，Ｆ2は、容量装荷電極１６と給電放射電極３間の容量調整によっても、調整されている。

【００２８】無給電放射電極４は給電放射電極３に間隔を介して近接配置され、給電放射電極３から電磁結合により信号が供給されるものである。この無給電放射電極４は、例えば図２の点線Ｂに示されるようなリターンロス特性を持ち、給電放射電極３側から供給された信号に基づいて共振周波数ｆ1やｆ2でもって共振してアンテナ動作を行う。この第１実施形態例では、無給電放射電極４の基本モードの共振周波数ｆ1は給電放射電極３の基本モードの共振周波数Ｆ1の近傍に調整されている。また、無給電放射電極４の高次モードの共振周波数ｆ2は給電放射電極３の高次モードの共振周波数Ｆ2の近傍に調整されている。

【００２９】この第１実施形態例では、無給電放射電極４は、給電放射電極３と同様に、誘電体基体２の上面２ａ上の面状パターン１３にスリット１４が設けられてループ形状に形成されており、この無給電放射電極４の開放端Ｐと、グランド端子部６に連通接続されているグランド端側Ｇとが間隔を介して対向配置されている。このため、無給電放射電極４においても、給電放射電極３と同様に、開放端Ｐとグランド端側Ｇ間の容量の調整によって、高次モードの共振周波数ｆ2が設定の周波数に調整されている。つまり、この第１実施形態例では、誘電体基体２は無給電側の開放端容量調整手段として作用している。また、無給電放射電極４の基本モードの共振周波数ｆ1は、電気長などによって調整されている。

【００３０】さらに、無給電放射電極４の近傍にも当該無給電放射電極４との間に容量を持つ容量装荷電極１７が形成されている。その容量装荷電極１７は誘電体基体２の後端面２ｃに形成されており、グランドに接地される。この容量装荷電極１７においても、給電放射電極３

の近傍の容量装荷電極１６と同様に、無給電放射電極４との間の容量を可変することによって、無給電放射電極４とグランド間の容量を可変することができて、無給電放射電極４の共振周波数ｆ1，ｆ2を調整することができる。

【００３１】この第１実施形態例では、無給電放射電極４と給電放射電極３は上記のようなリターンロス特性を有し、基本モード側と高次モード側との両方において複共振状態となり、表面実装型アンテナ１としては、図２の実線Ｃに示されるようなリターンロス特性を持つ構成と成している。

【００３２】ところで、無給電放射電極４と給電放射電極３の電磁結合量が不適切な場合には、例えば、無給電放射電極４の共振が減衰してしまう等の不都合な事態が生じて、良好な複共振状態を作り出すことができない。このことを考慮して、この第１実施形態例では、図２に示されるような良好な複共振状態を作り出すことができる適切な電磁結合量でもって給電放射電極３と無給電放射電極４を電磁結合すべく、その電磁結合量が調整されている。この電磁結合量の調整手法には様々な手法があるが、その一例として、給電放射電極３と無給電放射電極４間の間隙のうち、電界の強いＡ部分（図１（ａ）参照）の間隔を可変することにより電磁結合量を可変調整することが挙げられる。また、誘電体基体２の誘電率ε_rによって、給電放射電極３と無給電放射電極４の電磁結合量を調整する手法がある。この場合には、誘電体基体２は給電放射電極３と無給電放射電極４の電磁結合量を調整する結合量調整手段として作用する。

【００３３】この第１実施形態例によれば、誘電体基体２に給電放射電極３や無給電放射電極４を形成してアンテナを構成することにより、従来例に示した線状のアンテナ３０に比べて、格段にアンテナの小型化を図ることができる。また、この第１実施形態例では、給電放射電極３の近傍に無給電放射電極４を配設し、給電放射電極３と無給電放射電極４により複共振状態を作り出す構成としたので、周波数帯域の広帯域化を図ることが容易となる。したがって、小型化と、周波数帯域の広帯域化とを両方共に達成することが容易な表面実装型アンテナ１および無線機を提供することができる。

【００３４】さらに、この第１実施形態例では、給電放射電極３および無給電放射電極４はループ形状と成し、開放端Ｋと給電端部側Ｔ間（開放端Ｐとグランド端側Ｇ間）に容量を持たせる構成とした。この構成によって、その容量の調整により、高次モードの共振周波数Ｆ2，ｆ2を基本モードの共振周波数Ｆ1，ｆ1とほぼ独立させた状態で可変調整することができることとなる。これにより、給電放射電極３および無給電放射電極４の共振周波数を容易に調整することができることとなる。

【００３５】さらに、この第１実施形態例では、誘電体基体２に給電放射電極３および無給電放射電極４を形成したので、誘電体基体２の誘電率ε_rを可変することにより、給電放射電極３の開放端Ｋと給電端部側Ｔ間の容量や、無給電放射電極４の開放端Ｐとグランド端側Ｇ間の容量を大きく可変させることができる。このことから、給電放射電極３や無給電放射電極４の形状や大きさを大きく変化させることなく、つまり、大型化を防止しつつ、給電放射電極３や無給電放射電極４の高次モードの共振周波数Ｆ2，ｆ2を広範囲でもって調整することができる。これにより、表面実装型アンテナ１の設計の自由度を高めることができる。

【００３６】上記のように共振周波数の調整が容易で、しかも、給電放射電極３と無給電放射電極４間の間隔や、誘電体基体２の誘電率ε_rの調整によって給電放射電極３と無給電放射電極４の電磁結合量が適切に調整されることから、小型化を図り、かつ、デュアルバンドを含むマルチバンド化に対応することが可能となる。

【００３７】さらに、この第１実施形態例では、給電放射電極３および無給電放射電極４をループ形状としたので、給電放射電極３、無給電放射電極４の形成領域内に電界を閉じ込めることができることとなり、グランド側へ電界が捉えられてしまうことにより生じる周波数帯域の狭帯域化および利得劣化を防止することができる。特に、高次モード側において、その効果は顕著である。

【００３８】さらに、そのように電界が閉じ込められることにより、給電放射電極３と無給電放射電極４の電磁結合量の制御が容易となる。

【００３９】さらに、例えばグランドと見なされる物体が表面実装型アンテナ１に対して遠近移動する虞がある場合に、電界の閉じ込めが弱いと、そのグランドと等価な物体の移動によって、アンテナの利得が変動することがある。これに対して、この第１実施形態例では、給電放射電極３および無給電放射電極４がループ形状に形成されて、電界の閉じ込めが強くなることにより、表面実装型アンテナ１に対する物体の相対的な遠近移動に起因した特性変動を抑制することができる。このように、この第１実施形態例の構成では、給電放射電極３や、無給電放射電極４をループ形状とすることにより、周囲環境の影響を受け難く、安定した電波の送信あるいは受信を行うことができる表面実装型アンテナ１および無線機を提供することが可能である。

【００４０】以下に、第２実施形態例を説明する。なお、この第２実施形態例の説明において、第１実施形態例と同一構成部分には同一符号を付し、その共通部分の重複説明は省略する。

【００４１】この第２実施形態例では、図３（ａ）に示されるように、複数の無給電放射電極４（４ａ，４ｂ）が設けられていることを特徴としている。それ以外の構成は第１実施形態例とほぼ同様である。

【００４２】この第２実施形態例では、複数の無給電放射電極４ａ，４ｂは、給電放射電極３を間隔を介し挟み

込む形態で配置されており、一方側（無給電放射電極４ｂ）がループ形状と成している。

【００４３】また、図３（ｂ）に示されるように、この第２実施形態例においても、第１実施形態例と同様に、誘電体基体２の後端面２ｃには、給電放射電極３との間に容量を持ちグランドに接地される容量装荷電極１６が形成されると共に、無給電放射電極４ｂとの間に容量を持ちグランドに接地される容量装荷電極１７が形成されている。なお、もちろん、必要に応じて、無給電放射電極４ａとの間に容量を持つ容量装荷電極１７を設けてもよい。

【００４４】この第２実施形態例では、例えば、給電放射電極３の電気長や、給電放射電極３の開放端Ｋと給電端部側Ｔ間の容量や、給電放射電極３と容量装荷電極１６間の容量などが調整されて、給電放射電極３は、図４の鎖線Ａに示されるリターンロス特性を持つ構成と成している。

【００４５】また、この第２実施形態例では、無給電放射電極４ａは図４の鎖線Ｂａに示されるリターンロス特性を持ち、当該無給電放射電極４の基本モードの共振周波数ｆａ1は給電放射電極３の高次モードの共振周波数Ｆ2の近傍の周波数と成っている。また、ループ形状の無給電放射電極４ｂは図４の鎖線Ｂｂに示されるリターンロス特性を持ち、当該無給電放射電極４の基本モードの共振周波数ｆｂ1は給電放射電極３の基本モードの共振周波数Ｆ1の近傍の周波数と成っている。

【００４６】これら無給電放射電極４ａ，４ｂと、給電放射電極３とは電磁結合して良好な複共振状態を作り出すことができるように、無給電放射電極４ａと給電放射電極３の電磁結合量、および、無給電放射電極４ｂと給電放射電極３の電磁結合量がそれぞれ誘電体基体２の誘電率ε_rや放射電極３，４間の間隔などによって調整されている。これにより、給電放射電極３の基本モードと無給電放射電極４ｂの基本モードとが複共振状態を作り出し、また、給電放射電極３の高次モードと無給電放射電極４ａの基本モードとが複共振状態を作り出して、この第２実施形態例に示す表面実装型アンテナ１は、図４の実線Ｃに示されるようなリターンロス特性を有している。

【００４７】この第２実施形態例においても、第１実施形態例と同様の優れた効果を奏することができる。特に、この第２実施形態例では、複数の無給電放射電極４を設けたので、マルチバンド化に対応し易くなる。

【００４８】以下に、第３実施形態例を説明する。なお、この第３実施形態例の説明において、前記各実施形態例と同一構成部分には同一符号を付し、その共通部分の重複説明は省略する。

【００４９】この第３実施形態例において特徴的なことは、図５に示されるように、複数の給電放射電極３（３ａ，３ｂ）が誘電体基体２に形成されていることである。それ以外の構成は第２実施形態例とほぼ同様である。

【００５０】この第３実施形態例では、複数の給電放射電極３ａ，３ｂは間隔を介して並設されており、それら給電放射電極３ａ，３ｂのうちの一方側（給電放射電極３ｂ）がループ形状と成している。このような給電放射電極３ａ，３ｂを間隔を介して挟み込む形態で無給電放射電極４ａ，４ｂが形成されている。

【００５１】給電端子部５は給電放射電極３側が２つに分岐して各々給電放射電極３ａ，３ｂに連通接続されている。これにより、給電放射電極３ａ，３ｂは共通の給電端子部５を介して無線機の整合回路８を通って同じ信号供給源１０に信号接続されている。

【００５２】この第３実施形態例では、給電放射電極３ａは図６の点線Ａaに示されるようなリターンロス特性を有し、基本モードの共振周波数が周波数Fa1に調整されている。また、ループ形状の給電放射電極３ｂは鎖線Ａbに示されるようなリターンロス特性を有し、基本モードの共振周波数が周波数Ｆb1に調整され、また、高次モードの共振周波数が周波数Ｆb2に調整されている。さらに、無給電放射電極４ａは鎖線Ｂaに示されるようなリターンロス特性を有し、基本モードの共振周波数が周波数ｆａ1に調整されている。ループ形状の無給電放射電極４ｂは点線Ｂbに示されるようなリターンロス特性を有し、基本モードの共振周波数が周波数ｆｂ1に調整され、高次モードの共振周波数が周波数ｆｂ2に調整されている。

【００５３】この第３実施形態例においても、第１や第２の各実施形態例と同様に、給電放射電極３（３ａ，３ｂ）と、無給電放射電極４（４ａ，４ｂ）とが良好な複共振状態となるように、それら給電放射電極３と無給電放射電極４の電磁結合量が調整されている。これにより、表面実装型アンテナ１は、図６の実線Ｃに示されるようなリターンロス特性を有している。

【００５４】この第３実施形態例においても、前記各実施形態例と同様の優れた効果を奏することができる。その上、複数の給電放射電極３を設けたので、マルチバンド化がより一層容易となる。例えば、図６に示す周波数範囲Ｄ１がＧＳＭ（Global System for Mobile communication）に対応し、周波数範囲Ｄ２がＤＣＳ（Digital Celular System）に対応し、周波数範囲Ｄ３がＰＣＳ（Personal Communication System）に対応し、周波数範囲Ｄ４がＷ－ＣＤＭＡ（Wideband-Code Division Multiple Access）に対応し、周波数範囲Ｄ５がBluetoothに対応するように、給電放射電極３と無給電放射電極４の各共振周波数を設定することにより、５つの通信システムに対応することができることとなる。

【００５５】また、この第３実施形態例では、複数の給電放射電極３を形成したので、それら給電放射電極３ａ，３ｂが相互干渉することが懸念されるが、それら給

電放射電極３ａ，３ｂのうちの一方側がループ形状と成しているので、そのループ形状の給電放射電極３（３ｂ）における電界の閉じ込めに起因して、それら給電放射電極３ａ，３ｂの相互干渉を抑制することができる。

【００５６】なお、この第３実施形態例において、前記各実施形態例と同様に、誘電体基体２の後端面２ｃに、給電放射電極３との間に容量を持つ容量装荷電極１６や、無給電放射電極４との間に容量を持つ容量装荷電極１７を形成してもよいし、また、それら容量装荷電極１６，１７が無くとも、給電放射電極３や無給電放射電極４の周波数調整が成される場合には、それら容量装荷電極１６，１７は設けなくともよい。

【００５７】なお、この発明は上記各実施形態例に限定されるものではなく、様々な実施の形態を採り得る。例えば、無給電放射電極４の高次モードを用いない場合には、無給電放射電極４の高次モードの共振周波数ｆ2の制御を行わなくとも済むので、このような場合には、例えば、図７（ａ）に示されるように、無給電放射電極４はループ形状としなくともよい。

【００５８】また、第２や第３の実施形態例では、無給電放射電極４ａ，４ｂのうちの一方側のみがループ形状と成していたが、両方をループ形状としてもよい。また、第３実施形態例では、給電放射電極３ａ，３ｂのうちの一方側のみがループ形状と成していたが、両方をループ形状としてもよい。また、給電放射電極３や無給電放射電極４は３つ以上形成してもよく、その形成数は限定されるものではない。

【００５９】さらに、第１や第２の実施形態例では、容量装荷電極１６，１７が形成されていたが、容量装荷電極１６，１７を設けなくとも、給電放射電極３や無給電放射電極４の周波数調整を行うことが容易にできる場合には、容量装荷電極１６，１７を省略してもよい。

【００６０】さらに、上記各実施形態例よりも容量装荷電極１６と給電放射電極３間の容量、あるいは、容量装荷電極１７と無給電放射電極４間の容量を大きくした場合には、例えば、図７（ｂ）に示されるように形成してもよい。この場合には、上記各実施形態例よりも容量装荷電極１７の幅を広げ、かつ、無給電放射電極４の一部が容量装荷電極１７に向けて伸張形成されて、容量装荷電極１７と無給電放射電極４の対向面積を増加するように形成されている。

【００６１】さらに、第３実施形態例では、給電端子部５は給電放射電極３側が分岐した形状と成し、複数の給電放射電極３は共通の給電端子部５を介して同じ信号供給源１０に信号接続されていたが、例えば、図７（ｃ）に示されるように、表面実装型アンテナ１が表面実装する例えば回路基板２０に、複数の給電放射電極３を同じ信号供給源１０に信号接続させるための給電用パターン２１が形成されている場合には、各給電放射電極３専用の給電端子部５をそれぞれ誘電体基体２に形成する構成としてもよい。

【００６２】さらに、給電放射電極３と無給電放射電極４の各共振周波数は適宜に設定してよいものであり、図２や図４や図６に示す例に限定されるものではない。

【００６３】

【発明の効果】この発明によれば、基体には、ループ形状の給電放射電極が形成されると共に、給電放射電極との複共振状態を作り出す無給電放射電極が形成されているので、従来例に示した線状のアンテナに比べて、格段に小型化することができる上に、周波数帯域の広帯域化を図ることが容易となる。これにより、小型化と、周波数帯域の広帯域化とを両方共に達成することが容易となる表面実装型アンテナおよび無線機を提供することができる。

【００６４】無給電放射電極がループ形状と成しているものにあっては、給電放射電極だけでなく、無給電放射電極においても、開放端とグランド端側との間の容量を調整することによって、簡単に、基本モードの共振周波数を殆ど変化させずに高次モードの共振周波数を調整することができることとなる。これにより、例えば、複数の通信システムに対応した周波数帯域でもって電波の送信あるいは受信が可能となるように、給電放射電極と無給電放射電極の各基本モードと高次モードの共振周波数を調整することが簡単となり、マルチバンド化を容易に達成することができる。

【００６５】また、給電放射電極あるいは無給電放射電極がループ形状であることから、給電放射電極や、無給電放射電極の形成領域内に電界を閉じ込めることができることとなる。これにより、グランド側に電界が捉えられてしまうことに因る周波数帯域の狭帯域化および利得劣化を防止することができる。特に、そのような周波数帯域の狭帯域化および利得劣化は高次モード側において発生し易いが、ループ形状とすることにより、その問題発生を抑制できることとなる。

【００６６】さらに、ループ形状として、給電放射電極や、無給電放射電極の形成領域に電界を閉じ込めることにより、給電放射電極と無給電放射電極の電磁結合量の制御が容易となる。

【００６７】さらに、複数の給電放射電極を設けた場合には、それら複数の給電放射電極間での相互干渉が生じる虞があるが、ループ形状の給電放射電極では、電界が閉じ込められるので、そのループ形状の給電放射電極との相互干渉は抑制できて、各給電放射電極の共振動作の独立性を高めることが可能である。

【００６８】さらに、電界を閉じ込めることができるので、例えば、グランドと見なされる物体が表面実装型アンテナに対して遠近移動した際に、その物体の移動に起因した特性変動を抑制することができるという如く、外部の影響を受け難くなるという効果を奏することができる。

【００６９】面状パターンにスリットが設けられてループ形状に形成されているものにあっては、線状パターンによりループ形状を形成する場合に比べて、放射電極の面積を拡大することができる。

【００７０】基体が誘電体基体と成し、この誘電体基体が結合量調整手段としているものにあっては、給電放射電極と無給電放射電極の間隔を調整することに加え、誘電体基体の誘電率を可変することによって、給電放射電極と無給電放射電極間の電磁結合量を調整することができる。これにより、アンテナの大型化を防止しつつ、給電放射電極と無給電放射電極が広帯域化を図ることができる良好な複共振状態を作り出すことができるように給電放射電極と無給電放射電極間の電磁結合量を調整することができる。

【００７１】給電放射電極の開放端と給電端部側間の容量が誘電体基体の誘電率によって調整されているものや、無給電放射電極の開放端とグランド端部側間の容量が誘電体基体の誘電率によって調整されているものにあっては、給電放射電極や無給電放射電極の大きさや形状を殆ど変化させることなく、つまり、大型化を抑制しながら、高次モードの共振周波数を簡単に調整することができる。また、その高次モードの共振周波数の可変調整範囲を広げることができる。

【００７２】グランドに接地される容量装荷電極が給電放射電極あるいは無給電放射電極の近傍に容量を介して配置されているものにあっては、給電放射電極あるいは無給電放射電極と、容量装荷電極との間の容量を可変することによって、給電放射電極あるいは無給電放射電極と、グランドとの間の容量が可変して、給電放射電極あるいは無給電放射電極の共振周波数を調整することができる。これにより、共振周波数の調整をより一層行い易くすることができる。

【図面の簡単な説明】

【図１】第１実施形態例において特徴的な表面実装型アンテナの構成例を模式的な斜視図により示したモデル図である。

【図２】図１に示す表面実装型アンテナが持つリターンロス特性の一例を示すグラフである。

【図３】第２実施形態例において特徴的な表面実装型アンテナの構成例を模式的な斜視図により示したモデル図である。

【図４】図３に示す表面実装型アンテナが持つリターンロス特性の一例を示すグラフである。

【図５】第３実施形態例において特徴的な表面実装型アンテナの構成例を模式的な斜視図により示したモデル図である。

【図６】図５に示す表面実装型アンテナが持つリターンロス特性の一例を示すグラフである。

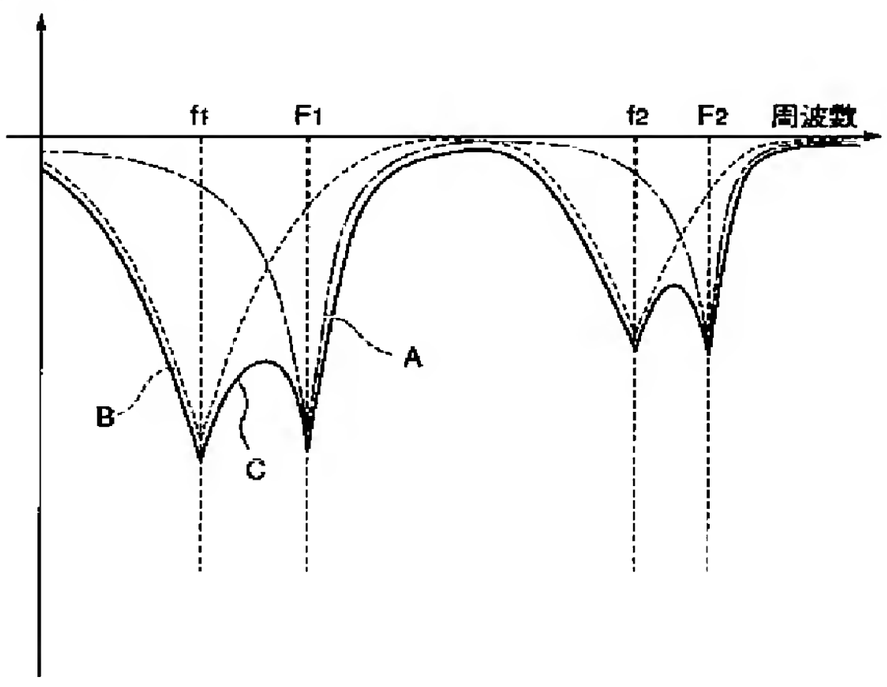
【図７】その他の実施形態例を説明するための図である。

【図８】従来例を示す説明図である。

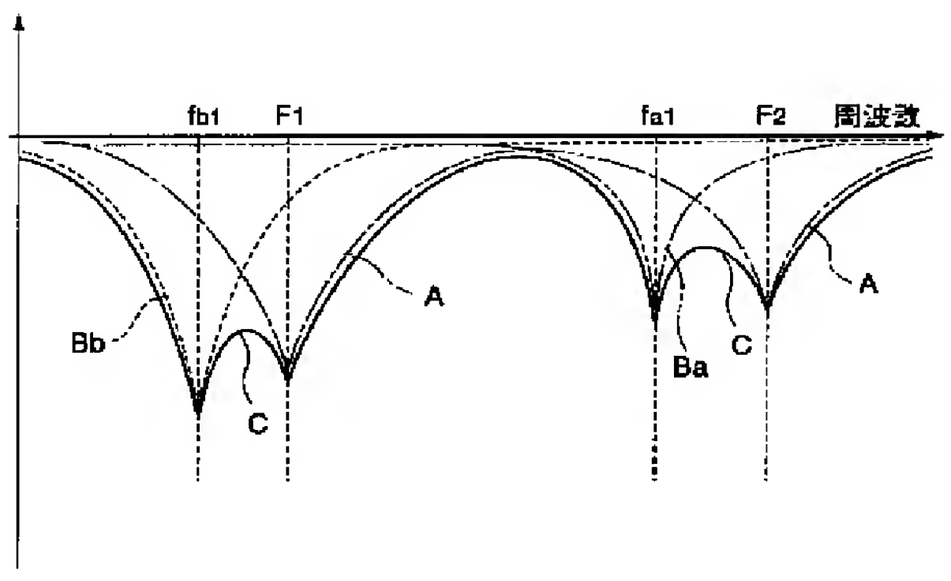
【符号の説明】

１　表面実装型アンテナ
２　誘電体基体
３　給電放射電極
４　無給電放射電極
１０　信号供給源
１１，１３　面状パターン
１２，１４　スリット
１６，１７　容量装荷電極

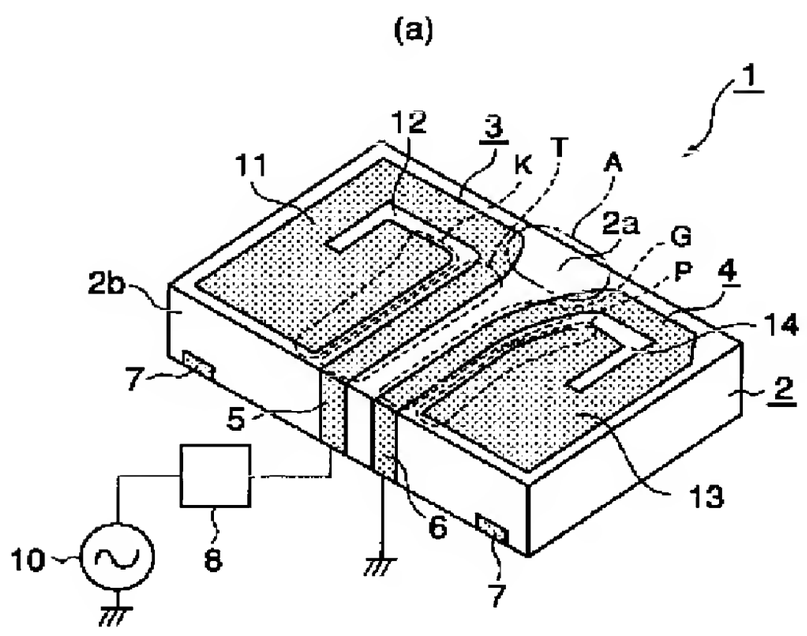
【図２】



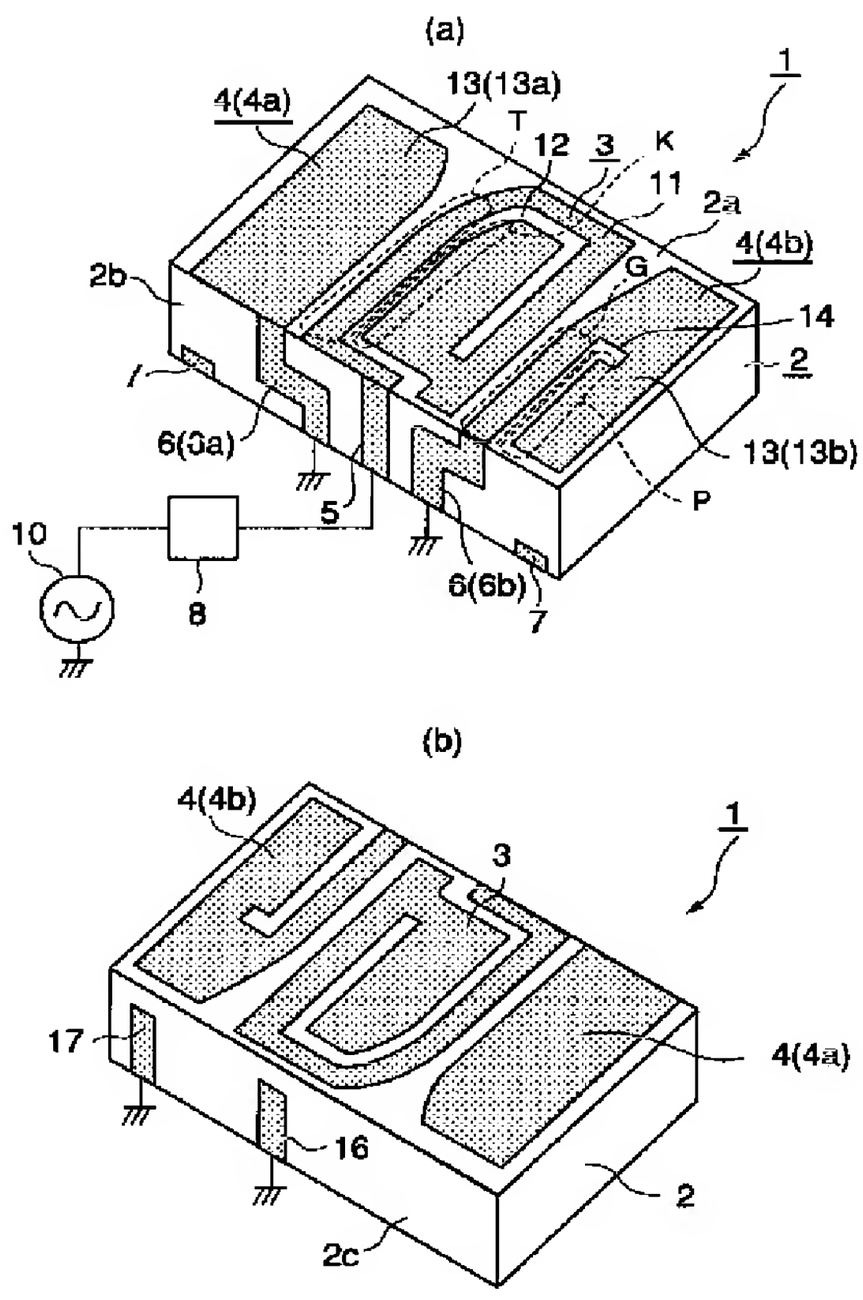
【図４】



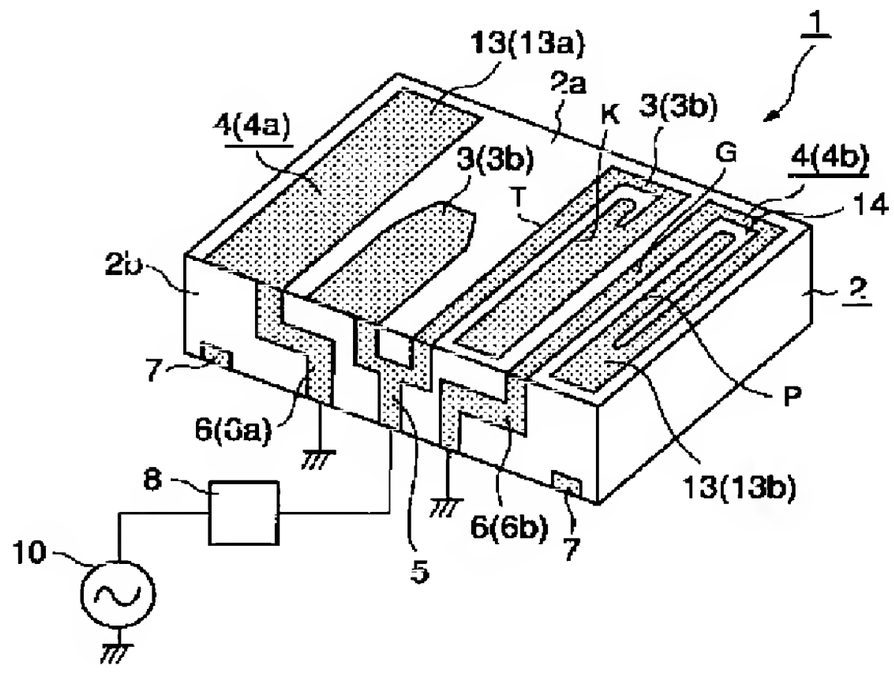
【図１】


(a)
1
12
3
11
K
T
A
2a
G
P
4
2b
14
7
5
2
13
10
8
6
7
(b)
2
4
3
17
2c
16

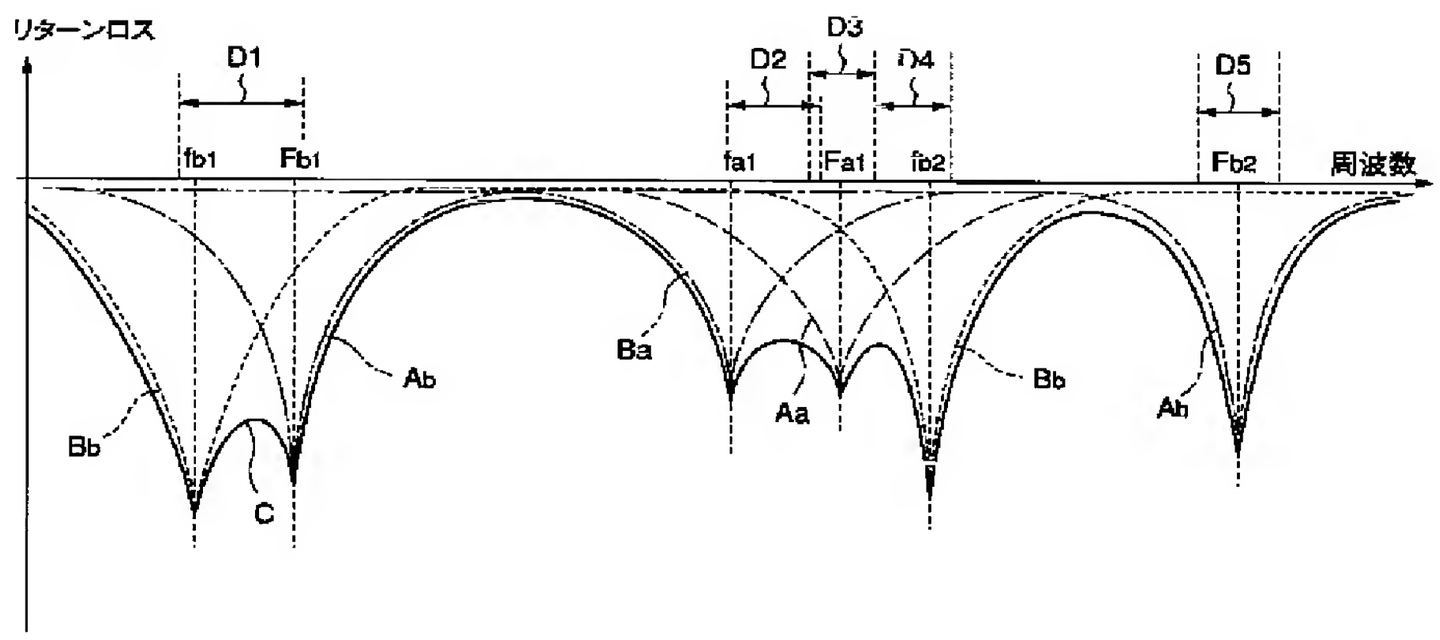
【図３】


(a)
1
4(4a)
13(13a)
T
12
3
K
11
2a
4(4b)
2b
G
14
2
6(3a)
13(13b)
P
5
10
8
6(6b)
7
(b)
4(4b)
3
1
17
4(4a)
16
2
2c

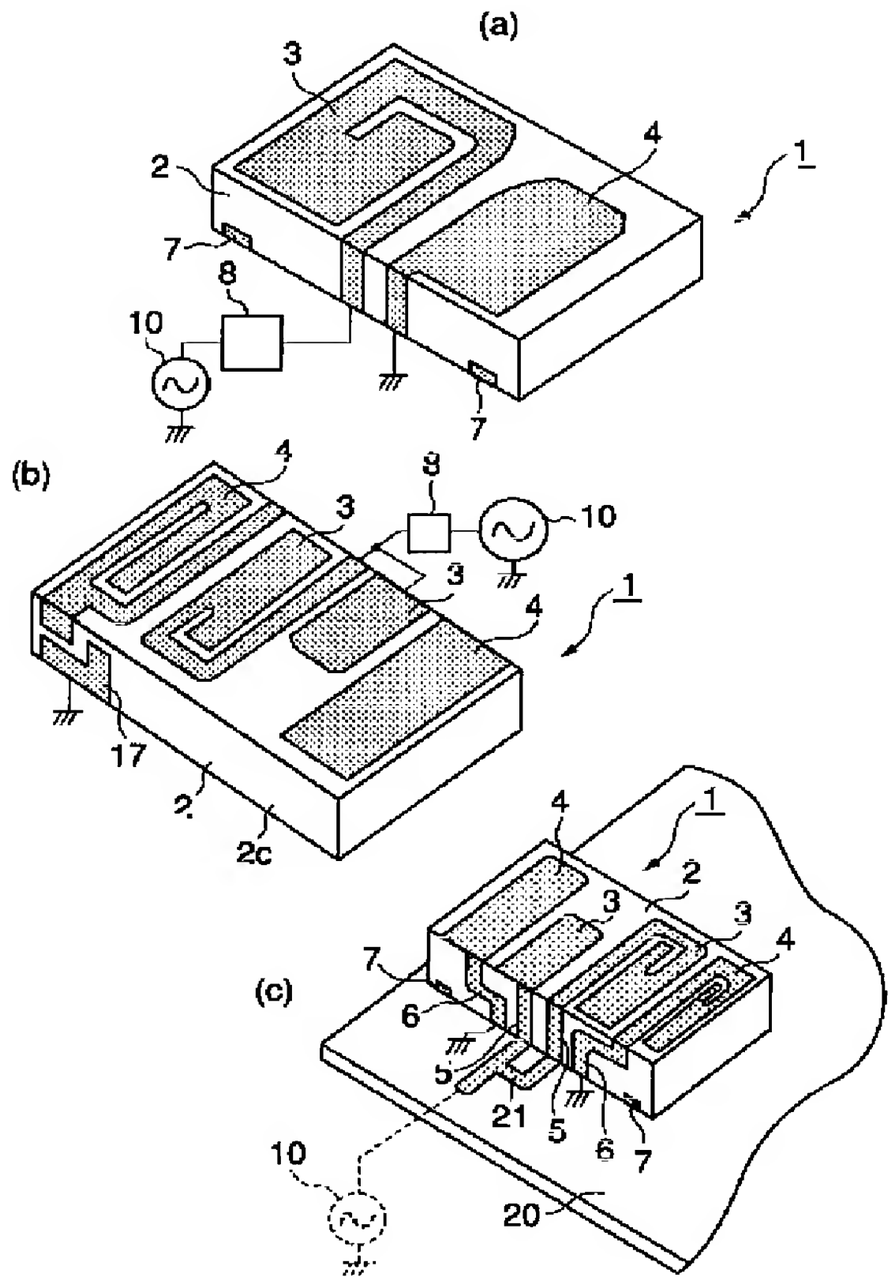
【図５】


1
13(13a)
2a
K
3(3b)
4(4a)
3(3b)
G
4(4b)
T
14
2b
2
7
P
6(3a)
13(13b)
8
10
6(6b)
7
5

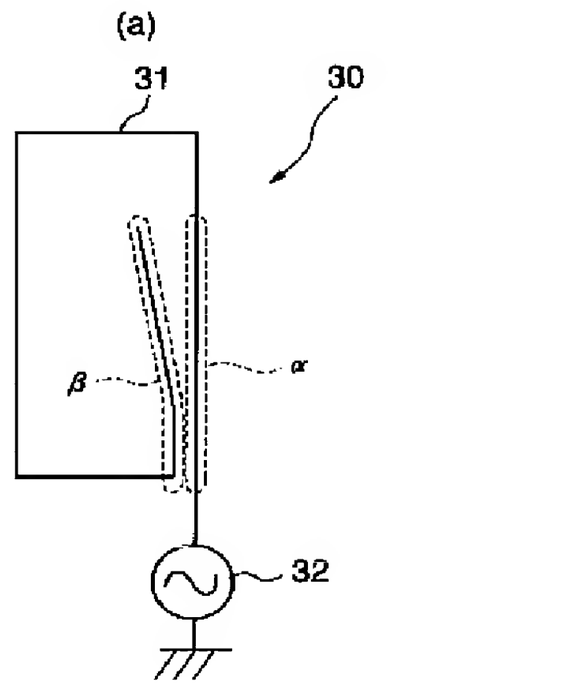
【図６】

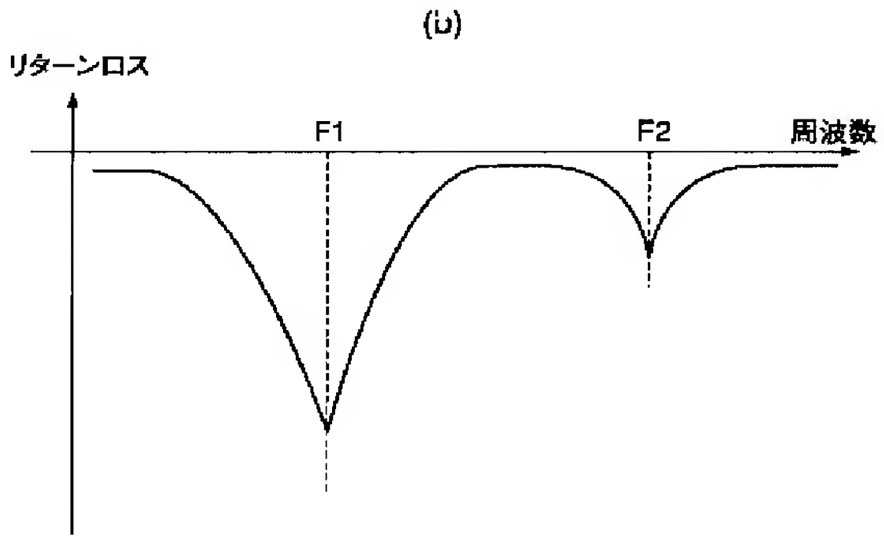


【図７】



【図８】





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5J047 AA04 AA07 AB11 AB13 FC06